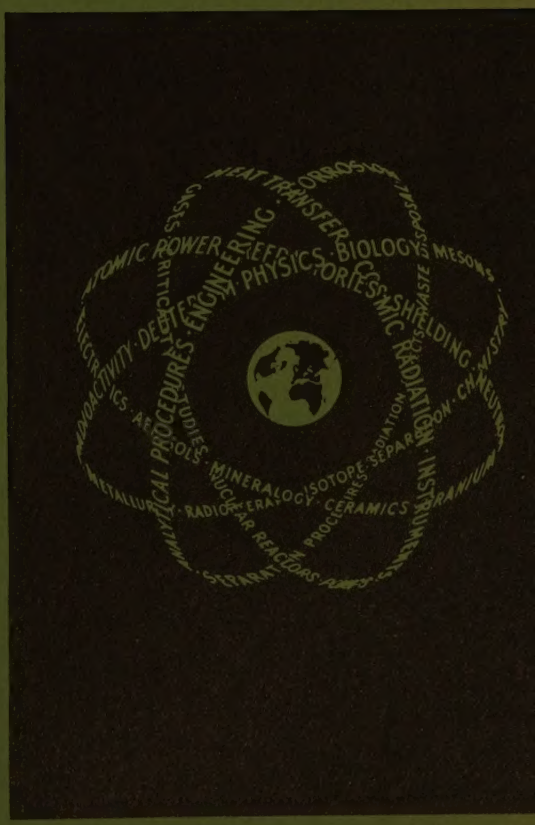
NUCLEAR SCIENCE ABSTRACTS



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Use of funds for printing this publication approved by the Director of the Bureau of the Budget February 3, 1959.

CONTENTS

Volume 14, Number 16, August 31, 1960

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NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 16 August 31, 1960

GENERAL AND MISCELLANEOUS

15487 ITR-1711

California. Univ., Livermore. Lawrence Radiation Lab.; Stanford Research Inst., Menlo Park, Calif.; and Sandia Corp., Albuquerque, N. Mex.

SUMMARY REPORT OF STRONG MOTION MEASUREMENTS, UNDERGROUND NUCLEAR DETONATIONS. W. M. Adams, P. L. Flanders, W. R. Perret, R. G. Preston, and D. C. Sachs. Jan. 1960. 89p. Project 26.0 [of] Operation HARDTACK, Phase II. OTS.

Subsurface and surface motion measurements were made on six underground nuclear detonations in the Oak Springs tuff of Nevada Test Site on Operation Hardtack II: Shots Mars (~13 tons), Tamalpais (~72 tons), Neptune (~90 tons), Logan (~5 kt), Evans (~55 tons), and Blanca (~19 kt). Free-field peak radial acceleration decreased as the inverse third or fourth power of slant range, as for Rainier. Particle velocities attenuated at a rate between the inverse square and inverse cube. Maximum radial and tangential subsurface stress varied as the inverse cube of radial range. Observed peak strain suggested attenuation at a rate between inverse cube and inverse square of range. Maximum upheaval at Blanca surface zero was about 25.5 feet; ~2.5 feet at 750 feet radial range; and 1.5 feet at 910 feet. Reed gage spectra indicated a shift of maximum energy to lower frequencies with increasing ground range. All components of surface acceleration followed an empirical equation of the form $A(g) = 3.2 \times 10^6 W^{0.7}(kt) R^{-2}(ft)$. All components of surface displacement did not follow a comparable relationship. Displacement is more precisely predicted than acceleration. The velocity of the tuff was determined to be 6200 ft/sec, with the velocity of the underlying dolomite 11,700 ft/sec. The crust at Nevada Test Site has a velocity of 6.58 km/sec and a thickness of ~30 km. The top of the mantle has a velocity of 8.08 km/sec and dips eastward. (auth)

15488 ORNL-1170(Del.)

Oak Ridge National Lab., Tenn.

AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 10, 1951. W. B. Cottrell, ed. Mar. 6, 1952. Decl. with deletions Oct. 27, 1959. 141p. Contract W-7405-eng-26. OTS.

The technical progress on the ORNL ANP Project is summarized. Topics covered include Circulating Fuel Aircraft Reactor, Liquid Metal Cooled Aircraft Reactor Experiment, reactor physics, critical experiments, nuclear measurements, experimental reactor engineering, chemistry of high temperature liquids, corrosion research, heat transfer research and physical properties, metallurgy and ceramics, radiation damage, supercritical water reactor, and analytical chemistry. (For preceding period see ORNL-1154.) (W.D.M.)

15489 ORNL-1294(Del.)

Oak Ridge National Lab., Tenn.

AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 10, 1952. W. B. Cottrell, ed. Aug. 5, 1952. Decl. with deletions Oct. 23, 1959. 127p. Contract W-7405-eng-26. OTS.

The technical progress of the research on the circulating fuel reactor and all other ANP research of the Lab is recorded. Topics covered include circulating fuel aircraft reactors, Circulating Fuel Aircraft Reactor Experiment, experimental reactor engineering, reactor physics, critical experiments, chemistry of high-temperature liquids, corrosion research, metallurgy and ceramics, heat transfer and physical properties research, radiation damage, and analytical chemistry. (For preceding period see ORNL-1227.) (W.D.M.)

15490 UCRL-5766

California. Univ., Livermore. Lawrence Radiation Lab.

THE NEPTUNE EVENT—A NUCLEAR EXPLOSIVE CRATERING EXPERIMENT. A. Vay Shelton, Milo D. Nordyke, and Robert H. Goeckermann. Apr. 19, 1960. 32p. Contract W-7405-eng-48. OTS.

The Neptune device was detonated underground in a room approximately $12 \times 17 \times 10$ ft, at the end of a hooked drift. The yield was 115 ± 15 tons. The shot and its effects are described and the major contributions of the data to the theory and prediction of cratering phenomenology are indicated. (W.D.M.)

15491 UCRL-5832

California. Univ., Livermore. Lawrence Radiation Lab.

NONMILITARY USES OF NUCLEAR EXPLOSIONS. Harold Brown. Jan. 6, 1960. 22p. Contract W-7405-eng-48. OTS.

Conversion of the sudden release of energy in explosions at extremely high temperature and pressure into the form of useful work, either mechanical, chemical, or thermal, must be accomplished in order for such explosions to have nonmilitary uses. The technical feasibility of such conversion in a number of different instances is discussed along with nuisance effects. Application of explosions in excavation, water resources, mineral and oil resources, power and isotope production, and scientific experiments is considered. (W.D.M.)

15492

MANNED NUCLEAR SPACE SYSTEMS. PART II. LOW-THRUST NUCLEAR SYSTEMS. R. F. Trapp, M. W.

Hunter, and E. B. Konecci (Douglas Aircraft Co., Inc., Santa Monica, Calif.). Aero/Space Eng. 19, No. 2, 49-54(1960) Feb.

The low-thrust nuclear system is discussed in the performance of a Martian mission. This system is compared to the high-thrust system presented earlier. The discussion is presented on the basis of a three year duration and an 85,000 lbs pay load. The specific weight of the energy source required to accomplish this mission is about 7.5 lbs/kw. Shielding methods and permissible radiological exposures were discussed for a maximum permissible yearly exposure of 12 rem. (B.O.G.)

15493

A COMPARISON OF NUCLEAR AND SOLAR POWER SYSTEMS FOR MANNED SPACE STATIONS. William C. Cooley (National Aeronautics and Space Administration, Washington, D. C.). Aero/Space Eng. 19, No. 5, 54-5; 100(1960) May.

Assuming an average power requirement of 3 kw, one nuclear system is compared to five types of solar power systems. Among the important factors which must be considered in selecting an auxiliary space power system are (1) reliability and endurance capability, (2) vehicle and mission compatibility, (3) safety (for nuclear systems), and (4) development and production costs. The over-all thermal cycle efficiencies and estimated weights of the systems are tabulated. The choice between a solar or nuclear system must be based on a detailed consideration of the specific mission requirements and the limitations imposed by the vehicle and the operational environment. (B.O.G.)

15494

THE FINANCING OF NUCLEAR ENERGY DEVELOPMENT. Karl Lanz. Atom u. Strom 6, 40-2(1960) Apr. (In German)

The financing of nuclear energy research and development in England and the United States is compared. The cost of uranium prospecting in Canada is mentioned. The cost of reactor development and construction is discussed. (J.S.R.)

15495

THE AVAILABILITY OF URANIUM FOR A NUCLEAR POWER INDUSTRY. Chauncey Starr and R. A. Laubenstein (Atomics International, Canoga Park, Calif.). Atomic Age, No. 1, 18p. (1960) Apr.

A study of the economically available resources of U in the USA and the world indicates that available U in the USA should be sufficient to maintain the nuclear power industry in this country until the year 2005, and that available U all over the world should be sufficient until 2050. This conclusion is based on the assumptions of no change in the prices of U, no advance in nuclear technology, and the reactor type being that of a high-temperature, high-specific power reactor (high T and SP). An increase in price of U_3O_8 to $23/lb would extend the limit in USA from 2005 to 2050. Improvements in nuclear technology, such as in conversion ratios, could extend this limit. It is concluded that high T and SI reactors have a promising future since they yield more electric energy per ton of U and will be less sensitive to possible increases in price. For example, present fuel costs for the low T and SP reactors with U_3O_8 at $10/lb are equivalent to those for the high T and SP reactors with U_3O_8 at $26/lb; such an increase in permissible fuel cost would increase U resources by a factor of six. Another way of obtaining more energy per ton of natural uranium would be through the development of a plutonium recycle or fast reactor. (D.L.C.)

15496

THE FUTURE DEVELOPMENT OF NUCLEAR POWER AND THE PERSPECTIVE DEVELOPMENT OF PRODUCTION COSTS OF POWER IN THE WORLD. Rudolf Pomerski. Nukleonika 4, 639-53(1959). (In Polish)

On the basis of papers presented at the Second International Conference and on later information—the future development of nuclear power in the world and the perspective development of production costs of power are shown. Conclusions concerning methods for future development of nuclear power in Poland are included. (auth)

15497

LONG-PERIOD SEISMIC WAVES FROM NUCLEAR EXPLOSIONS IN VARIOUS ENVIRONMENTS. Jack Oliver, Paul Pomeroy, and Maurice Ewing (Columbia Univ., Palisades, N. Y.). Science 131, 1804-5(1960) June 17.

Large nuclear explosions in the solid earth, the hydrosphere, and the lower and upper atmosphere have generated seismic waves of periods greater than about 5 seconds which have been detected at great distances from the source. (auth)

15498

PROPULSION SYSTEMS FOR SPACE FLIGHT. William R. Corliss. New York, McGraw-Hill Book Company, Inc., 1960. 307p. $10.00.

A survey is given of the important propulsion concepts for flight beyond the atmosphere. Nuclear rocket, ion drive, photon drive, and anti-gravity propulsion systems are compared in performance capability, technical feasibility, and state of development. The most critical problem of space propulsion—space power, is treated extensively by describing the proposed methods of generating power in space. A list of periodicals is given which frequently include articles of interest to space technology. (B.O.G.)

15499

PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM ON HIGH TEMPERATURE TECHNOLOGY, ASILOMAR CONFERENCE GROUNDS, CALIFORNIA, OCTOBER 6-9, 1959. New York, McGraw-Hill Book Company, Inc., 1960. 354p.

A compilation of papers given at a symposium on high-temperature technology is presented. Included are several papers in the areas of techniques and measurements, materials, processes, behavior of materials, research abroad, and general discussions. Separate abstracts were prepared for 22 selected papers. (J.R.D.)

BIOLOGY AND MEDICINE

General and Miscellaneous

15500 TID-6052

Delaware. Univ., Newark and Oak Ridge National Lab., Tenn.

SOME EFFECTS OF OXYGEN ON THE INSECTS, ANAGASTA KUEHNIELLA AND TENEBRIO MOLITOR. Arnold M. Clark and V. J. Cristofalo. [1959]. 20p. Contract AT(30-1)-1752. OTS.

The effects of oxygen at increased partial pressures upon the development and oxygen consumption of larvae and pupae of Anagasta kuehniella and Tenebrio molitor were studied. Anagasta pupae exposed to 15 psi or more of oxygen are prevented from emerging as adults. For 15 psi of oxygen, development of the pupae to the adult stage continues within the pupal skin but most of these remain entrapped within the pupal skin. Pupae exposed to 30 psi

or more of oxygen may become paralyzed and show a marked and irreversible decrease in oxygen consumption. Most of the Tenebrio pupae exposed to 120 psi of oxygen show a marked and irreversible decrease in oxygen consumption and an inability to become pigmented. Paralysis and inability to pigment are correlated with and, probably a consequence of, decreased oxygen consumption. Most of the Tenebrio pupae exposed to 60 psi of oxygen become pigmented but do not develop to the adult stage and emerge. Both larvae and pupae are injured by oxygen and by x rays. Larvae however are more oxygen resistant and radiation sensitive than pupae. The oxygen consumption of pupae is not decreased by exposure to 50,000 r. These differences indicate that different mechanisms of actions are involved in injury by oxygen and by x rays. (auth)

15501

ARTIFICIAL RADIOISOTOPES FOR USE IN MEDICAL RADIOGRAPHY. I. A. Bochvar, V. E. Busygin, and U. Ya. Margulis. Atomnaya Energ. 8, 376-7(1960) Apr. (In Russian)

The spectral distribution of bremmstrahlung and γ radiation of 1.4 g/cm^2 thick Tm^{170} was analyzed and dose yields were evaluated. The data show the soft part of the spectrum (0.03 to 0.1 Mev) forms only 41.4% of the total dosage. Correlations of γ constants of 0.045 r/h for Tm^{170} and 0.51 r/h for Eu^{155} show the dose per curie of Eu^{155} is 11.3 folds higher than that for Tm^{170}. In tests with Tm^{170} and Eu^{155}, $1 \times 1 \times 1$ mm metallic obstructions placed in the middle of 160-mm-thick phantoms and cracks (0.6 mm) in bone tissue in 160-mm-thick objects were detected. Thinner cracks (0.3 mm) were recorded in objects not over 80 mm in thickness. Pictures taken using Sr^{90} and Y^{90} are much poorer. The Eu^{155} radioscope produces a clearer picture; however, the exposure time in medical gamma radiography is about 10 to 15 times slower than the medically acceptable time. (R.V.J.)

15502

PHOTOPERIODIC BEHAVIOR OF SUNFLOWER. Hubert J. Dyer, John Skok, and Norbert J. Scully (Brown Univ., Providence and Argonne National Lab., Lemont, Ill.). Botan. Gaz. 121, 50-5(1959) Sept.

The sunflower, Helianthus annuus L., var. Mammoth Russian, has been shown to be a short-day type plant. It will, however, flower under a wide range of photoperiodic conditions, including excessively long days (as long as 20 hours) and a regime in which the daily dark periods are interrupted by 1-hour light periods if it be permitted to grow for a sufficiently long period. Short photoperiods promote flowering both by hastening the initiation of flower primordia and by hastening the development of primordia into macroscropic floral structures. Interruption of the dark periods by light is effective in inhibiting both the initiation of flower primordia as well as the development of primordia into macroscopic floral structures. Sunflower thus exhibits a wide range of photoperiodic conditions under which flowering may take place plus an unusual variability in the time of flowering among individual plants in a given population. This may be related to the phenomenon pointed out by Habermann and Wallace: that a certain maturation requirement or vegetative growth requirement for flowering must be met before flowering can occur. Stem elongation in sunflower is favored by long photoperiods. (auth)

15503

STRONTIUM AND CALCIUM METABOLISM IN METABOLIS BONE DISEASES. Elias C. Dow and John B. Stanbury (Massachusetts General Hospital, Boston and Harvard Medical School, Boston). J. Clin. Invest. 39, 885-903(1960) June.

The distribution and excretion of Sr^{85} and Ca^{45} administered simultaneously and intravenously were studied in patients with thyroid and parathyroid disorders, osteoporosis, and Paget's disease. In all cases and at all times the body retention of Ca^{45} was more than Sr^{85} retention by a factor of 1.1 to 5.7. Differential renal clearance of the two isotopes accounted for 1.9 to 8.1 times more Sr^{85} than Ca^{45} in the urine. The amounts of each isotope in the feces were sizable, generally equal, and varied little in the different diseases studied, except in Paget's disease. Calcium pools and compartment sizes as determined by either isotope proved to be sensitive indices of skeletal function. The largest values were found in Paget's disease and thyrotoxicosis and the lowest in myxedema. One patient with thyroid cancer metastatic to bone showed no evidence of increased calcium turnover by any of the criteria employed. A patient with hyperparathyroidism but no clinical evidence of bone disease showed no evidence of abnormal calcium or strontium dynamics. In one patient with Paget's disease cortisone failed to suppress completely the activity of the disease as measured by Ca^{45} dynamics. There was no unusual pattern of labeled isotope excretion in patients with osteoporosis. Prolonged estrogen therapy in one patient with osteoporosis of the postmenopausal type effected no change in skeletal kinetics as measured by the metabolism of Ca^{45} or Sr^{85} but did effect a change in the serum to urine Ca^{45} specific activity ratio. The observation that Ca^{45} specific activities were consistently greater in serum than in urine and the variation of serum to urine ratios in different disease states is discussed as representing either a true phenomenon or a systematic analytical error. Strontium-85 qualitatively parallels Ca^{45} as an index of skeletal function in metabolic bone diseases. (auth)

15504

THE METABOLISM AND FATE OF TRITIATED THYMIDINE IN MAN. Joseph R. Rubini, Eugene P. Cronkite, Victor P. Bond, and T. M. Fliedner (Brookhaven National Lab., Upton, N. Y.). J. Clin. Invest. 39, 909-18(1960) June.

The metabolism and fate of tritiated thymidine were studied in two patients in hemopoietic equilibrium. Plasma clearance of H^3-thymidine commences in the first circulation time and becomes exponential following apparent equilibrium with total body water. Two components with half-times of 0.2 minute and 1.0 minute were identified and discussed. The rapid plasma clearance of H^3-thymidine was associated with incorporation of this compound into newly formed DNA of proliferating cells as early as one minute after injection. Labeling of proliferative cells of the bone marrow was nearly complete within ten minutes after injection, and thereafter the label appeared to remain in these cells or their progeny for their life span. diluted only by successive mitoses. This short availability time of intravenous H^3-thymidine simplifies the analyses of the time parameters of labeled proliferating cell populations. About one-third of the H^3-thymidine was catabolized to THO within a few hours after injection. Small amounts of urine nonvolatile H^3 activity were excreted in the urine during the first day after injection. H^3-β-aminoisobutyric acid was identified in these urines as a catabolic product of H^3-thymidine. Degradation and possible reutilization of the H^3 label is discussed. Severe malnutrition resulted in greater degradation of H^3-thymidine to THO and urine nonvolatile H^3 activity. (auth)

15505

RADIOACTIVE COLLOIDAL GOLD IN THE TREATMENT OF CARCINOMA OF THE UTERINE CERVIX. S. I. Pavlenko, O. M. Nosalevich, and E. M. Krastina (Khar'kov

Inst. of Medical Radiology, USSR). Med. Radiol. 5, No. 4, 15-19(1960) Apr. (In Russian)

Treatment of 18 patients with the second stage of carcinoma of the uterine cervix (parametric variant) with Au^{198} is described. A total of 40 to 50 mc of Au^{198} was introduced interstitially into one or both parametrii by a special apparatus. An expanded extirpation of the uterus with appendages, following the method of Gubarev-Wertheim, was performed on 16 patients after an interval of 24 to 40 days. Apart from Au^{198} administration, the patients were subjected to x-ray and gamma therapy, before and after the operation, and in some instances also to intracavitary radium irradiation. A description is given of the procedure adopted for Au^{198} introduction, clinical observations, and microscopic changes in the tissues of the true pelvis following Au^{198} administration. (auth)

15506

THE DISTRIBUTION AND EXCRETION OF Rb^{86} IN THE ANIMAL ORGANISM. Yu. I. Moskalev, V. G. Kulikova, and S. A. Rogacheva. Med. Radiol. 5, No. 4, 47-52(1960) Apr. (In Russian)

The distribution and excretion of radioactive Rb^{86} in intravenous and peroral introduction of the preparation were studied in 50 rats. In intravenous administration, Rb^{86} was rapidly removed from the blood channel; in 5 minutes only 1.7% of rubidium was found in the blood. In the blood, rubidium was contained predominantly in the blood corpuscles. The largest quantity was deposited in the muscles (up to 67.6%), liver (up to 10.8%), kidneys (up to 7.2%), skin (up to 9.6%), and skeleton (up to 7.0%). Rubidium was discharged mostly with the urine. The total amount of rubidium discharged with the urine and feces for 8 days comprised 32.8%. In peroral administration it was completely absorbed by the intestine. The character of distribution and accumulation in the organs and the intensity of Rb excretion with the urine and feces were the same as in intravenous introduction. A comparison of results obtained by previous authors showed that the distribution of rubidium is identical with that of K and Cs. (auth)

15507

PHYSICO-CHEMICAL PROPERTIES OF A NEW RADIOTHERAPEUTIC PREPARATION CONTAINING P^{32}. V. I. Levin, N. G. Serebryakov, and M. D. Kozlova. Med. Radiol. 5, No. 4, 53-5(1960) Apr. (In Russian)

A radiotherapeutic preparation consisting of two oppositely charged colloidal solutions of zirconyl phosphate and P^{32} was prepared. Prior to their use both preparations are mixed together in different proportions. In this conjunction the enlargement of colloidal particles occurs, the degree of which (until complete coagulation) depends upon the volume ratio adopted in mixing the solutions. (auth)

15508

INVESTIGATION OF THE AQUEOUS CHLOROFORM SOLUTION AS A DOSIMETER OF ROENTGEN AND GAMMA-RADIATION. I. K. Sokolova. Med. Radiol. 5, No. 4, 68-72 (1960) Apr. (In Russian)

The results of an investigation of an aqueous chloroform solution as a dosimeter of x rays and gamma radiation are presented. A simple technique of measuring the resistance of solutions was used as a method of analysis. The studies revealed that the readings of the dosimeter are linear within the range of dose values of 4×10^3 to 3×10^5 r and do not depend upon the amount of the dose within the limits of 1.3 to 130 r/sec. The dosimeter was not able to show the rate of "hard irradiation" with changes in radiation energy from 100 kev (Cu = 0.35) to 1.25 Mev. An insignificant dependence of dosimeter readings on the temperature was noted. In the course of one month after the irradiation the readings of the dosimeter changed by 20%. (auth)

15509

OBSERVATIONS ON THE RADIODIAGNOSTICS OF SEEDS. Gian Tommaso Scarascia (Comitato Nazionale per le Richerche Nucleari, Rome). Nuovo giorn. botan. ital. [N.S.] 66, 289-95(1959). (In Italian)

Method of x-ray photography is a useful complement of the analysis of the germination capacity of seeds. Results obtained in the Genetics Department of the Swedish Forest Research Institute are described and other cases in which this method can advantageously be applied are briefly indicated. (auth)

15510

ANOMALOUS GROWTH OF MICROORGANISMS PRODUCED BY CHANGES IN ISOTOPES IN THEIR ENVIRONMENT. Ernest Borek and D. Rittenberg (Columbia Univ., New York). Proc. Natl. Acad. Sci. U. S. 46, 777-82(1960) June.

Observations on Escherichia coli led to the conclusion that the phenomena observed when organisms are transferred from H_2O to D_2O should not be ascribed merely to the toxicity of the rare isotope, for they occur under the reversed conditions as well. Water is apparently toxic to organisms grown in D_2O or in H_2O^{18}. (C.H.)

15511

RADIOGRAPHY WITH THE AID OF A THULIUM PREPARATION. V. V. Zodiev, V. V. Dmokhovskiĭ, and L. A. Maslov (Scientific-Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Vestnik Rentgenol. i Radiol. 35, No. 2, 62-7(1960) Mar.-Apr. (In Russian)

A series of improvements was introduced for Tm^{170} diagnostic apparatus. The apparatus showed good efficiency in locating and investigating bone breakage in extremities (but not fine cracks) and in locating foreign metallic bodies. Further improvements of the apparatus are now in progress. (R.V.J.)

15512

International Atomic Energy Agency, Vienna.
APPLICATION OF HIGH ENERGY RADIATIONS IN THERAPY. Bibliographical Series No. 1. Sophie V. Stephens and K. C. Tsien, comps. 1960. 86p. $1.00.

A bibliography is given for the application of high-energy radiation in therapy; it is divided into three parts, historical and general reviews, radioisotope teletherapy units, and supervoltage therapy with accelerators. The last two parts are divided into several sections dealing with the different types of radiation sources, and each section has two sub-sections on physical aspects and clinical applications. The entries in each sub-section are arranged alphabetically by author, and an inclusive author index is given. The main sources of references are also given. (D.L.C.)

Biochemistry, Nutrition, and Toxicology

15513 TID-5981

Pittsburgh. Univ. Graduate School of Public Health.
LUNG HAZARDS FROM INHALED RADIOACTIVE PARTICULATE MATTER. Progress Report [for] July 15, 1956 to July 14, 1957. Report No. 9. Herman Cember. July 15, 1957. 65p. Contract AT(30-1)-912. OTS.

Progress is reported in studies on the toxic effects of radioactive particles in the pulmonary tract of rats. Data are included on the effects of insufflated thallium-204 loaded clay particles, implanted glass beads containing strontium-90, chronically insufflated $BaSO_4$ containing sulfur-35, and acutely insufflated cerium-35-fluoride particles. Results are included from studies on the pulmonary retention of $Ce^{144}F_3$ and $Hg^{203}S$ particles. (C.H.)

15514

CHEMICAL EFFECTS OF IONIZING RADIATION ON DEOXYRIBONUCLEIC ACID IN DILUTE AQUEOUS SOLUTION. G. Hems (Royal Cancer Hospital, London). Nature 186, 710-12(1960) May 28.

Reactions involved in the radiation chemistry of purine and pyrimidine neucleotides in dilute aqueous solution are described. Results are reviewed on radiochemical changes after irradiation of samples of calf thymus from four separate preparations. (C.H.)

15515

SALIVA-SERUM RATIOS OF TRITIUM AFTER THE ADMINISTRATION OF TRITIATED WATER. A. J. Coppen and J. L. Gibbons (Maudsley Hospital, London). Nature 186, 724-5(1960) May 28.

Data are tabulated on the saliva/serum ratios of tritium after the administration of tritiated water in human subjects. (C.H.)

15516

COMPARISON OF LEACHING AND FIXATION OF POTASSIUM AND RUBIDIUM IN SOILS USING THE ISOTOPES K42 AND Rb86. A. Øien, G. Semb, and K. Steenberg (Norwegian Coll. of Agriculture, Vollebekk). Soil Sci. 88, 284-7(1959) Nov.

In an experiment with soil columns, the leaching of rubidium and that of potassium were compared by adding equivalent amounts of KCl and RbCl to the top of the columns, followed by leaching with water corresponding to about a 110-mm rainfall. The distribution of rubidium and that of potassium were determined by tracer methods with the isotopes Rb^{86} and K^{42}. There was no loss of rubidium or potassium in medium heavy clay, but the rubidium was more concentrated in the upper part of the columns than was potassium. This was found also to be true in sand, though here both elements had moved further down than in the clay soil. The leaching loss of potassium in the two experiments was about twice that of rubidium. In fixation experiments it was found that rubidium was fixed more strongly than potassium. (auth)

Fallout and Ecology

15517

SECRETION OF I^{131} FROM A DAIRY COW AFTER AN ORAL ADMINISTRATION OF A SINGLE DOSE IN AQUEOUS SOLUTION. Kjell Steenberg (Norwegian Coll. of Agriculture, Vollebekk). Acta Agr. Scand. 9, 198-203 (1959). (In English)

An aqueous solution of 700 μc of I^{131} was administered orally to a lactating cow. Measurements of activities were carried out in milk, urine, feces, and blood in order to determine radioiodine content. The secretion of I^{131} into the milk during the first 11 milkings after the administration, the excretion in urine for 23 days, and results of measurements of I^{131} in blood plasma at 4 different occasions, have been plotted. (auth)

15518

ENTRY OF RADIOACTIVE FALLOUT INTO THE BIOSPHERE AND MAN. Wright Langham and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.). Bull. schweiz. Akad. med. Wiss. 14, 434-78(1958).

Testing of atomic weapons through mid-1957 produced about 5.5 mc of Sr^{90} and varying amounts of other long- and intermediate-lived isotopes. Of these, Sr^{90} poses the greatest potential hazard to world health. Cs^{137} and Pu^{239} are the other principal long-lived activities in weapons debris Sr^{90} and Cs^{137} were measured quantitatively in people, milk, and other foodstuffs, and the intermediate-lived I^{131} was detected in the thyroids of man and domestic animals. Two theories were proposed for distribution of weapons debris throughout the world. The Libby model postulates uniform, rapid mixing of weapons debris throughout the stratosphere with equal leakage back through the tropopause, after which it is deposited over the earth's surface in relation to tropospheric meteorological conditions. The Machta model proposes slow, unequal stratospheric mixing with preferential leakage through the tropopause in the vicinity of the jet streams. Qualitatively, the two models give the same distribution pattern. Quantitatively, the Machta model predicts more nonuniform fall-out with higher surface deposition levels at approximately 40° N. and 40° S. latitudes. Entry of fission debris into the biosphere and man is a function of the soil-plant relationships and metabolic properties of the individual radionuclides. All radionuclides may enter the biosphere through direct deposition on vegetation and through the soil-to-plant-to-milk-to-man ecological cycle. Ecological discrimination may be expected to occur, and it is possible to estimate over-all discrimination ratios for various countries from per capita consumption of principal foods and the discrimination factors at the various steps along the ecological cycle. Estimates are presented of average maximum equilibrium levels in the population under conditions of no more weapons tests and continued tests at the past 5-year rate. (C.H.)

15519

STRONTIUM-90 IN THE TOTAL DIET. Consumer Repts. 25, 289-93(1960) June.

Food, milk, and drinking water representative of the total diet of a hungry teen-ager were collected in 24 cities throughout the United States and one in Canada. The diets were analyzed for strontium-90 content. Results are compared with the strontium-90 levels in milk samples collected in the same cities. Results indicate that milk furnished only slightly more than half of the strontium-90 consumed in the total diet. (C.H.)

15520

THE RELATIVE QUANTITY OF ROOT UPTAKE AND LEAF RETENTION FOR CONTAMINATION OF RED CLOVER (TRIFOLIUM PRATENSE) WITH RADIOACTIVE FISSION PRODUCTS UNDER 1959 FALLOUT CONDITIONS. Kernenergie 3, 390-2(1960) Apr. (In German)

Fall-out contamination of Red Clover (Trifolium pratense) was studied. Root uptake and lead retention were measured in an experimental planting which allowed each process to take place in separate boxes of plants by covering some of them, and using fission-product free soil in some. The results are tabulated and discussed. (T.R.H.)

15521

SODIUM/POTASSIUM RATIO IN RAIN-WATER. A. T. Wilson (Victoria Univ. of Wellington, N. Z.). Nature 186, 705-6(1960) May 28.

Factors affecting the sodium/potassium ratio in rain water are discussed. (C.H.)

15522

OPREDELENIE ZAGRYAZNENII BIOSFERY PRODUCTAMI

YADERNYKH ISPYTANIĬ (SBORNIK STATEĬ). (Determination of the Contamination of Biosphere by Products from Nuclear Test. Symposium). V. P. Shvedov, ed. Moscow, Akademiya Nauk SSSR, 1959. 253p.

Topics considered in the symposium include monitoring the concentration of radioactive product in the atmosphere; the density of fall-out products; concentrations of radioactive nuclides in the air; various methods for measuring β activity, including studies by means of γ spectrometers; determination of the age of products by the rate of β activity; measuring the radioactivity for the years 1955 to 1958 in the Neva River; and radiochemical analysis and dosimetry of Sr^{90} in soil and food. (R.V.J.)

Radiation Effects on Living Tissues

15523 AD-228105

Baylor Univ., Houston, Tex. Coll. of Medicine and Jefferson Davis Hospital, Houston, Tex.

A STUDY OF THE EFFECTS OF TOTAL AND PARTIAL BODY RADIATION ON IRON METABOLISM AND HEMATOPOIESIS. Period covered: December 1, 1958–August 31, 1959. Vincent P. Collins, C. T. Teng, and Walton D. West. 21p. Contract DA-49-007-MD-428.

Progress is reported in studies on the response of the hematopoietic system to fractionated doses of whole-body radiation. Factors which influence tolerance to whole-body radiation exposure are discussed. Radiation effects on the absorptive function of intestinal mucosa were studied by measuring absorption of radioiodine labeled serum albumin before and after limited field or whole-body radiation. The clinical and hematopoietic response following whole-body radiation with shielding of critical areas was studied in a pilot experiment using laboratory animals. (C.H.)

15524 AF-SAM-60-33

Oak Ridge National Lab., Tenn.

SOLUBILITY OF HEMOGLOBIN AS A RED CELL MARKER IN IRRADIATED MOUSE CHIMERAS. Raymond A. Popp and G. E. Cosgrove. Oct. 7, 1959. 8p.

Genetically different mouse hemoglobins differ in solubility and crystal formation. Differences in hemoglobin solubility and crystal formation can therefore be used to identify homologous erythrocytes in irradiated mouse chimeras if the hemoglobin types of donor and recipient mice are distinguishable by these properties to begin with. (auth)

15525 SCTM-261-55(51)

Sandia Corp., Albuquerque, N. Mex.

ELECTROCARDIOGRAPH MEASUREMENTS AT OPERATION TEAPOT. H. H. Sander and O. J. Birdsong. Dec. 5, 1955. 22p. OTS.

Electrocardiograms were taken on dogs, inside 50-man underground personnel shelters located 1050 feet from ground zero, during and after atomic detonations. All the equipment operated successfully, and none of the dogs was killed by the blast. Seven hours of recording were obtained on each of the dogs. Samples of the electrocardiograms are included. (C.H.)

15526 TID-6051

Delaware. Univ., Newark.

THE RELATION OF GENOME NUMBER TO RADIOSENSITIVITY. [Period covered] June 1, 1959 to May 31, 1960. Arnold M. Clark. June 7, 1960. 13p. Contract AT(30-1)-1752. OTS.

Progress is reported in studies on the effects of oxygen on insects, a comparison of radiation damage and oxygen poisoning, and the effects of x radiation on the life span in haploids and diploids of Habrobracon. (C.H.)

15527 TID-6053

Delaware. Univ., Newark and Oak Ridge National Lab., Tenn.

SOME EFFECTS OF X RAYS ON LONGEVITY IN HABROBRACON FEMALES. Arnold M. Clark. [1958]. 21p. Contract AT(30-1)-1752. OTS.

Habrobracon females when exposed to x rays as larvae, pupae, or adults show a decrease in adult life span which is shortened in proportion to the amount of radiation absorbed. Radiation damage to larvae and pupae which cannot be detected simply by observing the incidence of adults that emerge, is revealed when adult life span is measured. Groups irradiated as adults show no immediate decrease in survivors. The time of onset of death within the group depends upon the amount of radiation absorbed. Death is delayed for a longer time for smaller doses. Although adults will survive a dose of 200,000 r, as little as 5,000 r causes a reduction in life span. (auth)

15528 TID-6054

New York. State Univ., Albany. Research Foundation.

EFFECTS OF IRRADIATION ON THE CALCIFYING MECHANISM OF EPIPHYSEAL CARTILAGE. Period Covered: May 16, 1959–May 15, 1960. Albert Hirschman. June 1, 1960. 13p. Contract AT(30-1)-1913. OTS.

Progress is reported in studies on the effects of irradiation on the calcifying mechanism of epiphyseal cartilage. A correlative study was made of irradiation effects on slices of rachitic epiphyseal cartilage in vitro on their calcifiability and stainability with toluidine blue. Data are presented from morphological observations on samples exposed to x radiation of 250,000, 500,000, and 1,000,000 r. Mitosis stopped within 2 to 4 days in the tibial epiphysis of normal young rats exposed to 4,000 r x radiation. Observations are reported up to 44 days post-irradiation. Growth curves of the increase in length of the bones after irradiation and of the weights of the animals are included. (C.H.)

15529 AEC-tr-4079

EFFECT OF IONIZING RADIATION ON THE ELECTRIC ACTIVITY OF THE BRAIN. (Deĭstvie Ioniziruyushchikh Izlucheniĭ na Electricheskuyu Aktivnost Mozga). A. I. Danilenko and N. D. Stetsenko. ON THE ACTIVITY OF BETA-RADIATIONS OF HUMAN BLOOD. (Ob Aktivnosti β-Izlucheniya Krovi Cheloveka). A. I. Danilenko. Translated from a publication of the A. A. Bogomolets Institute of Physiology, Academy of Sciences of the Ukrainian S.S.R., Kiev, 1956. 10p. JCL or LC.

Measurements were made on the amplitude and frequency of changes in the encephalographs of dogs following the intravenous administration of phosphorus-32. Data are presented graphically showing reactions after administration of several dose levels of phosphorus-32 after intervals of five minutes to one year. Data are also presented from an analysis of blood samples for radioactivity. Results on normal persons are compared with results on persons working with radioactive substances and with results on individuals suffering from various diseases and traumas. Slight differences were observed in the three groups. (C.H.)

15530 JPRS-L-926-N

THE EFFECT OF IONIZING RADIATION ON IMMUNITY. V. L. Troitskii (Troitskiy) and M. A. Tumanyan. Translated from Med. Radiol. 4, No. 5, 91-3(1959). 8p. OTS.

Accumulated data are summarized on the effects of ionizing radiation on immunity. (C.H.)

15531 JPRS-L-960-N

ON THE EFFECT OF IONIZING RADIATION ON THE HUMAN NERVOUS SYSTEM. V. F. Sayenko-Lyubarskaya. Translated from Fiziol. Zhur. Akad. Nauk Ukr. R.S.R. 5, 261-9(1959). 17p. OTS.

Symptoms connected with the effects of irradiation on the central nervous system are described which were observed in patients receiving therapeutic doses of radium or x radiation. The symptoms often remained for one to two months after the conclusion of the radiation treatment. In many patients who tolerated the therapy without symptoms, a disequilibrium of the nervous system was observed. Data are reviewed from a number of other studies on the radiosensitivity of the nervous system. (C.H.)

15532

INVESTIGATION OF THE CURATIVE EFFECT OF LYCOPENE IN IRRADIATED MICE. Arne Forssberg, Gunnar Walinder, Minoru Fujita, and Gudrun Dreyfus (Karolinska Institutet, Stockholm). Acta Radiol. 53, 392-400(1960) May. (In English)

The action of lycopene administered after irradiation was investigated in a large series of mice. Some of the experiments showed that the results were improved by an initial dose of polyphloretin phosphate (PPP). A possible increase in suprarenal function in the treated animals was observed. (auth)

15533

COMPARATIVE EFFECTS OF PRENATAL GAMMA RADIATION AND X-IRRADIATION ON THE REPRODUCTIVE SYSTEM OF THE RAT. Benjamin H. Ershoff and Ved Brat (Western Biological Labs., Culver City, Calif.). Am. J. Physiol. 198, 1119-22(1960) May.

Experiments were undertaken to determine the comparative effects of prenatal x irradiation and gamma radiation from a cesium-137 source on the development and morphology of the reproductive system of the young rat. Findings indicate that a sex difference in response occurred. The male offspring of rats exposed to either 300 r x irradiation (administered as a single dose at the rate of 17.92 r/min) on the 18th day of pregnancy or to 300 r gamma radiation administered continuously from the 13th to 20th day of pregnancy (at a dose rate slightly less than 0.03 r/min) exhibited a significant degree of gonadal injury. In female offspring, the ovaries were normal in size and appearance in the case of rats whose mothers were administered x irradiation, but were significantly reduced in size and contained neither follicles nor corpora lutea when the mother rats received gamma radiation. (auth)

15534

DOSE-RATE EFFECTS ON MICE AND RATS IN THE RANGE 2 TO 340 RADS/MINUTE. J. F. Fowler and J. M. Lawrey (King's Coll. Hospital, London). Brit. J. Radiol. 33, 382-8(1960) June.

The effect of 230 kv x rays at two different intensities has been compared in three biological systems: skin and hair reactions of mouse legs were compared after single doses of about 2,000 rads given at 340 or 65 rads/minute; the percentage mortality of mice was compared for doses of approximately the LD_{50} given at 95 or 10 rads/minute; and the rate of emptying of rats' stomachs was compared for doses of 50 and 100 rads given at 36 or 2 rads/minute. The higher dose-rate was, in general, more effective, but the differences were small. (auth)

15535

A STUDY OF THE EFFECT OF RADIATION ON BACTERIAL CELLS IN THE HUMID MICROCHAMBER OF THE ELECTRON MICROSCOPE. I. G. Stoyanova, T. A. Nekrasova, and V. I. Biryuzova. Doklady Akad. Nauk S.S.S.R. 131, 195-8(1960) Mar. 1. (In Russian)

Direct observations in an electron microscope showed no obvious morphological damage to Bacillus mycoides and B. mecentericus cells exposed to 10^6 to 5×10^6 r of ionizing radiation. With increased dosage to 10^7 to 10^8 r, the cell disturbances took place immediately following the exposure. Cell polymerization took place with exposure to 10^9 r. (R.V.J.)

15536

PRELIMINARY PSEUDOALLELIC ANALYSIS OF X-RAY INDUCED MUTATIONS AT THE DUMPY LOCUS IN D. MELANOGASTER. Elof A. Carlson and J. L. Southin. Drosophila Inform. Serv. 33, 124-5(1959).

A series of x-ray-induced dumpy mutations in Drosophila melanogaster, obtained at doses of 4000 and 1000 r administered to mature spermatozoa, was examined for gross and minute structural damage to genetic material. A recombinational analysis method was applied in testing the mutant with its neighboring genes for the presence or absence of crossing over. Data are tabulated and results are discussed. (C.H.)

15537

IMPORTANCE OF THE SKIN IN WHOLE-BODY IRRADIATION OF RATS. L. Andrén and S. Welin (Allgemein Krankenhaus, Malmö, Sweden). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. 92, 567-72(1960) May. (In German)

Using a suitable experimental arrangement, a total-body irradiation excluding the skin was carried out on rats, and the effect-dose relationship was analyzed. The LD 50/50 d was found to be 2850 r skin dose for experimental animals of the same strain and under identical conditions using 250 kv 920 r skin dose. The loss of the function of the skin causes death. The useful effect of a grid on the spatial distribution of radiation can be demonstrated. (auth)

15538

THE MUTUAL RELATIONSHIP OF SPLEEN AND BONE MARROW IN RADIATION REACTIONS. III. THE EFFECT OF THE SPLEEN ON THE REACTION PATTERN OF BONE MARROW AFTER WHOLE-BODY IRRADIATION. R. Bauer and H. Hartweg (Universität, Tübingen, Ger.). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. 92, 572-8(1960) May. (In German)

The peripheral leucocytosis which is observed after splenectomy is unaccompanied by any demonstrable change in the bone marrow. Splenectomized animals, on the other hand, show earlier and more intense regeneration of blood-forming foci after total body radiation than do omentectomized or irradiated control animals. The differences in the phases of marrow regeneration found in totally and partially irradiated animals are discussed. The previously demonstrated release effect of splenectomy on the bone marrow depends on the functional state of the latter. Resting marrow is apparently not affected, or at least not demonstrably so; proliferating marrow shows a marked and prolonged effect. (auth)

15539

CHRONIC GAMMA IRRADIATION EFFECTS ON THE MUTABLE V AND STABLE R LOCI IN A CLONE OF NICOTIANA. Seaward A. Sand, Arnold H. Sparrow, and Harold H. Smith (Connecticut Agricultural Experiment Station, New Haven; Brookhaven National Lab., Upton, N. Y., and Cornell Univ., Ithaca, N. Y.). Genetics 45, 289-308(1960) Mar.

Data are presented for somatic and germinal effects of chronic gamma irradiation on a mutable allele of the V

gene and on the stable R gene both of which affect flower color in a clone of Nicotiana. Growing plants of the heterozygous clone (v_{s3}/v_s, R/r) were subject to different levels of chronic gamma irradiation. The somatic effect on a mutable gene system was compared with a stable gene system in the same tissue by counting speckled sectors and purple sectors on irradiated and control plants. Similarly, germinal effects on the same gene systems were studied by counting speckled and purple individuals in progeny from the irradiated and control plants. Results are reported and discussed. (C.H.)

15540

POSTIRRADIATIVE EFFECTS ON CHROMOSOMAL ABERRATIONS IN TRADESCANTIA MICROSPORES. Alvin V. Beatty and Jeanne W. Beatty (Emory Univ., Atlanta). Genetics 45, 331-44(1960) Mar.

The CO effect in relation to chromosomal aberration production in oxygen is operative on the recovery mechanism since immediate postirradiative treatment with CO yielded the same number of aberrations as irradiative treatment. As determined by the CO effect, all rejoining, as far as two-hit aberrations are concerned, was completed within ten minutes after irradiation. All experiments in which irradiation was done in air followed by an immediate postirraditive treatment in helium, showed a posttreatment effect by an aberration yield higher than was obtained with posttreatment in air. In all the experiments where helium was used followed by air a decrease in aberration yield was found. These data are interpreted as supportive evidence that the availability of energy for chromosome rejoining directly influences the two-hit aberration yield in such a way that postirradiative aerobic conditions favor restitution over exchanges while postirradiative anoxic conditions favor exchanges over restitution. The results from fractionation experiments indicate that some of the breaks produced in air or in helium when postirradiatively treated in air remain open and available for use in the production of two-hit aberrations for approximately 30 minutes, and that breaks postirradiatively treated in helium remain open for a longer period. (auth)

15541

INFLUENCE OF A RADIOMIMETIC SUBSTANCE (MECHLORETAMINE) ON THE NUCLEOTIDE AND PROTEIN CONTENT OF LIVER CELLS. L. Cima, G. Fassina, F. Pozza, and E. C. Tóth (Università, Padua). Ital. J. Biochem. 9, No. 1, 23-32(1960) Jan.-Feb. (In English)

The effect of mechloretamine (HN2) administered endovenously to rats has been studied on the nucleotide and protein content of liver cells. Temporary inhibition of nucleic acid synthesis and depolymerization of these compounds were observed similarly to what had been found with x irradiation. By means of electrophoresis, an increase in the faster fractions of the soluble proteins (albumin and pre-albumin) was found similarly to what had been observed with ionizing radiations. The similarity between the terminal effects on nucleotide and protein metabolism exerted by radiations and radiomimetic substances are discussed in the light of our present knowledge on the mechanism of action of these agents. (auth)

15542

EFFECT OF GAMMA RADIATION ON LEATHERS AND PICKLED CALFSKIN. Victor G. Vely, Nicholas D. Gallagher, and Maynard B. Neher (Battelle Memorial Inst., Columbus, Ohio). J. Am. Leather Chemists' Assoc. 55, 202-19(1960) Apr.

Exposure of vegetable-tanned, chrome-tanned and retanned leathers, and pickled calfskin to gamma radiation has been demonstrated to have a detrimental effect on the materials as shown by lowering of the shrinkage temperature, breaking strength, and elongation properties. The greatest damage occurred at the highest level of irradiation. Statistical analysis by matched-pair variance analysis of the data showed that very high significance could be attached to the decreases in physical properties obtained on all leathers irradiated to 10^8 and 10^7 reps. Irradiation at 10^6 reps caused significant decreases in shrinkage temperature of all the leathers; weak or no significance could be attached to the decreases in breaking strength and elongation properties. No significance could be attached to differences between pickled calfskin control samples and specimens irradiated to 10^6 reps. Irradiation at 10^7 reps produced highly significant decreases in shrink temperature and breaking strength properties. Irradiation of pickled calfskin in the presence of certain organic compounds normally considered to be innocuous as tanning agents failed to induce tanning effects. Gluteraldehyde, probably because of its tanning ability, moderated the detrimental effects of irradiation. (auth)

15543

STUDIES ON THE Cx-REACTIVE PROTEIN. III. THE EFFECT OF IRRADIATION OF RABBITS ON THE ACUTE PHASE PROTEIN SYSTEM. Harrison F. Wood, Sonia Anderle, Carolyn W. Hammond, and C. Phillip Miller (Irvington House, Irvington-on-Hudson, N. Y., New York Univ. Coll. of Medicine, New York, and Univ. of Chicago). J. Exptl. Med. 111, 601-9(1960) May 1.

Young adult rabbits were subjected to a single total-body exposure of x radiation ranging from 50 to 1200 r and tested frequently for the presence of Cx-reactive protein in their blood. It usually appeared in two phases separated by an interval of several days. The primary phase occurred 24 to 48 hours after irradiation in almost all rabbits exposed to 500 r or more, and in 4 of 16 exposed to 300 r or less. The secondary phase occurred during the 2nd week in many of the rabbits irradiated with 900 r or more and in a few irradiated with 700 r. Autopsy cultures failed to demonstrate the presence of infection in rabbits which died or were sacrificed during the primary phase. Bacterial infection was demonstrated, however, in almost all rabbits autopsied and cultured during the secondary phase. After the disappearance of the primary phase in rabbits exposed to 700 or 900 r, the secondary phase could be elicited by initiating bacterial infection. Within 6 to 24 hours after intravenous inoculation of E. coli, Cx-reactive protein reappeared in the blood and persisted until death or termination of the experiment. Reappearance of the protein also followed the intravenous injection of killed E. coli but it disappeared again 1 to 2 days later. The results indicate that the primary phase is elicited by radiation injury per se and the secondary phase by bacterial infection. (auth)

15544

THE PHAGOCYTIC FUNCTION DYNAMICS OF BLOOD GRANULOCYTES IN DIFFERENT METHODS OF RADIATION THERAPY. A. S. Ozol (Kazan Medical Inst., USSR). Med. Radiol. 5, No. 4, 19-23(1960) Apr. (In Russian)

A marked difference was found to exist between the effect of the radiation energy upon the phagocytic function dynamics of granulocytes in neoplasm-stricken patients undergoing an external irradiation with single doses of 200 r and that observed in persons subjected to a continuous irradiation within the tissues by radioactive needles. The latter procedure produced a mild, stimulating effect upon the phagocytic function of granulocytes (observed in 20 out of 36 patients). In 13 patients variations of phago-

cytic indices did not exceed the limits observed in healthy subjects and it was only in 3 instances that the phagocytosis dynamics fell 1.6 to 1.9 times below the initial level. External fractional irradiation with a high radiated power exerted a more accentuated effect upon the phagocytic function of granulocytes. In most instances it acted stimulatingly, but a fall in the phagocytosis dynamics occurred 2.7 times more frequently than it did with the continuous irradiation, and was also considerably greater, 1.8 to 3.6 times below the initial level. (auth)

15545

CHANGES IN THE CEREBRAL CIRCULATION OF AN ANIMAL UNDER A WHOLE-BODY IONIZING IRRADIATION. R. M. Lyubimova-Gerasimova. Med. Radiol. 5, No. 4, 24-9(1960) Apr. (In Russian)

Vascular disturbances in the animal brain were studied after a total single irradiation with a dose of 1000 r of x or gamma rays. Serial angiography and photography of pial vessels via a cranially implanted plexiglass port were used to evaluate the condition of cerebral vessels. The experiments were staged on rabbits and proved that, consequent upon a whole-body administration of 1000 r of ionizing radiation, clearly-pronounced circulatory disturbances occurred in the central nervous system. Each stage of the radiation sickness was characterized by definite hemodynamic disturbances. Immediately upon irradiation, while passing through the spasmodic stage occasioning a certain reduction in the blood flow, the cerebral vessels begin to dilate rather quickly. Twenty-four hours after irradiation the changes became stabilized and manifested themselves in an accentuated dilation of the venous portion of the vascular system. During the next stage, however, the circulation became normalized. At the height of the sickness the hemodynamic disturbances began to gather momentum, with the vessels tending to contract and to assume a bead-like shape. Further on, the vascular pattern acquired uniformity, the brain became anemic, and the blood flow diminished. The above disturbances were ordinarily observed 1 to 2 days prior to the death of the animal. (auth)

15546

THE EFFECT OF MERCAMINE IN EARLY RADIATION INJURIES OF THE BONE MARROW. I. K. Krasnykh, N. P. Lebkova, and S. P. Yarmonenko. Med. Radiol. 5, No. 4, 35-7(1960) Apr. (In Russian)

The effect of mercamine on the degenerative changes in the bone marrow cells provoked by ionizing radiation in the first hours after its application was investigated in experiments on albino rats and mice, irradiated with doses of 200, 700, and 800 r. Luminescent microscopy and the procedure of total preparations revealed that mercamine tends to reduce the number of degenerated cellular nuclei and inhibits the formation of micronecrotic foci in the bone marrow of experimental animals. A comparison of these data with the results of hematological investigations suggested the presence of a relationship between the hematopoietic regeneration, accelerated under the effect of mercamine and the inhibitory influence of this drug upon the degeneration of functional elements in hematopoietic organs. (auth)

15547

THE EFFECT OF RADIATION ON VITAMIN B_1 METABOLISM. REPORT II. Iori Ueno (Inst. of Medicine, Univ. of Kyoto). Med. Radiol. 5, No. 4, 38-42(1960) Apr. (In Russian)

The effect of radiation on the changes in the blood level of vitamin B_1 and changes of vitamin B_1 excretion in urine was investigated. (auth)

15548

THE SENSES OF TASTE AND SMELL IN PERSONS WORKING ON BETATRONS. L. V. Kuznetsova. Med. Radiol. 5, No. 4, 82-4(1960) Apr. (In Russian)

The senses of taste and smell of 100 persons, 29 to 40 years old, who were working on betatrons for periods of 4 to 10 years were examined. They all worked in conditions of combined effect of penetrating radiation. It was shown that the sense of taste decreases to all stimuli, mainly to the bitter stimulus. The olfactory thresholds were increased to all substances used as stimuli. The absence to any complaints on impairment of the sense of smell points to the gradually developing hyposmia. Simultaneous diminution of the sharpness of taste and smell was noted in 43% of the cases. The central character of the analyzer changes in the given group of persons was determined. The olfactory thresholds were increased in healthy persons working on betatrons even after small doses of ionizing radiation. (auth)

15549

EFFECT OF OXYGEN ON THE INACTIVATION OF TRYPSIN BY IONIZING RADIATION. J. A. V. Butler and A. B. Robins (Royal Cancer Hospital, London). Nature 186, 697-8(1960) May 28.

Data are presented graphically showing the effect of oxygen on the sensitivity of trypsin to ionizing radiation. (C.H.)

15550

EFFECT OF OXYGEN AND NITRIC OXIDE ON THE RADIOSENSITIVITY OF HUMAN CELLS IN TISSUE CULTURE. D. L. Dewey (Mount Vernon Hospital, Northwood, Middx, Eng.). Nature 186, 780-2(1960) June 4.

An improved procedure is described for studying the effect of oxygen and nitric oxide on the radiosensitivity of human cells in tissue culture. Data are included on the survival of human cells after 200 kv x radiation during equilibration with oxygen, air, nitrogen, and 0.275% oxygen in nitrogen, and 10% nitric oxide in nitrogen. (C.H.)

15551

THE EFFECT OF TOTAL IRRADIATION ON THE ISOHEMAGGLUTINATING PROPERTIES OF THE BLOOD IN DOGS. M. N. Novikova (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 4, No. 10, 6-8(1959).

Results are reported from a study of the changes in the isohemagglutinating properties of the blood of dogs under the influence of various doses of ionizing radiation. The transfusion of a small volume of incompatible blood caused aggravation of the radiation sickness and provoked the development of a hemorrhagic syndrome. It was concluded that there was a superimposition of the effects of transfusion of incompatible blood on the relatively weak manifestations of the effects of ionizing radiation. (C.H.)

15552

A STUDY OF THE IRON METABOLISM IN IRRADIATED DOGS WITH STIMULATION OF THEIR ERYTHROPOIETIC FUNCTION. L. L. Shepshelevich (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 4, No. 10, 9-16(1959).

Preliminary repeated bleeding of dogs subjected to whole-body irradiation with a dose of LD_{50} caused an increase in the erythropoietic function of the bone marrow during the first 10 days. Preliminary single bleeding of dogs subjected to whole-body irradiation with doses of LD_{75}

and LD_{95} favors preservation of the normal erythropoietic function of bone marrow. A study of the metabolism of iron-59 in dogs irradiated with a dose of LD_{95} after a preliminary single bleeding also showed the presence of a more intensive erythropoiesis in these animals. (C.H.)

15553

INVESTIGATIONS ON THE THROMBOPLASTIC ACTIVITY OF THE BLOOD AND PROTHROMBIN CONTENT IN PERSONS SUBJECTED TO IONIZING RADIATION. N. N. Pushkina (F. F. Erisman Scientific-Research Inst. of Health and Hygiene, Moscow). Problems Hematol. Blood Transfusion (U.S.S.R.)(English Translation) 4, No. 10, 58-61(1959).

Results are reported from measurements of the prothrombin content and thromboplastic activity of the blood of scientific workers exposed to small amounts of radiation over varying periods of time. The prothrombin content of the blood was normal regardless of length or intensity of radiation exposure. The calcium content was normal, but the content of chlorides in the blood was lower in those receiving larger doses of radiation. A decrease in thromboplastic activity corresponded to a decrease in the chloride content of the blood. Clinical symptoms observed in the experimental group are summarized. (C.H.)

15554

NEOPLASIA FOLLOWING THERAPEUTIC IRRADIATION FOR BENIGN CONDITIONS IN CHILDHOOD. Eugene L. Saenger, Frederic N. Silverman, Theodor D. Sterling, and Malcolm E. Turner (Univ. of Cincinnati and Children's Hospital, Cincinnati). Radiology 74, 889-904(1960) June.

A series of 1,644 persons of a total of 2,230 who were irradiated over the head, neck, and chest in infancy and childhood was compared with 3,777 siblings with respect to subsequent medical history. Eleven carcinomas of the thyroid were found in the patient group; none were found in the sibling controls. This incidence of carcinoma of the thyroid in the irradiated group is about one-hundred times that expected from current tables of morbidity and is comparable to that reported in other similar surveys. The incidence of infections and other non-neoplastic illness was greater among the patients than among their siblings. But a statistically significant difference in the mortality ratio in the two groups was also found, i.e., the death rate in the siblings was greater than that in the patients. Although there is a significant increase in the incidence of cancer of the thyroid following irradiation, radiation does not appear to be the sole factor responsible for the increased incidence but rather a contributing factor. This survey differs from previously reported surveys in the extent to which the total family health history was evaluated. The information obtained is extremely useful in placing in proper perspective possible carcinogenic factors other than radiation. (auth)

15555

RADIATION AND LEUKEMIA IN CARCINOMA OF THE CERVIX. Norman Simon, Marshall Brucer, and Raymond Hayes (Oak Ridge Inst. of Nuclear Studies, Tenn.). Radiology 74, 905-11(1960) June.

Questionnaires concerning the number of leukemia cases developing in survivors of radium-treated cancer of the cervix were answered by 36 of the collaborators in the Annual Report on the Results of Treatment in Cancer of the Uterus. In more than 71,000 patients there appeared 12 cases of leukemia that may have been associated with radiation and an additional 4 cases of chronic lymphatic leukemia. A determination of the person-years at risk shows an incidence of leukemia of from 62 to 115 cases per million. This is essentially the same incidence as in women of similar ages in the United States and England. It may be concluded, therefore, that radium treatment for cancer of the cervix does not induce an increase in the incidence of leukemia among the survivors. (auth)

15556

LIFE SHORTENING AND TUMOR PRODUCTION BY STRONTIUM-90. Victor E. Archer and Benjamin E. Carroll (National Institutes of Health, Hagerstown, Md.). Science 131, 1808-9(1960) June 17.

A linear relationship between dose of internal radiation and two effects, which implies no threshold, is shown to be a possible interpretation of data given by Finkel in "Mice, men and fallout." This interpretation is at variance with that offered by Finkel, which was that the dose-effect relationship is nonlinear and indicates a threshold. (auth)

15557

INVESTIGATIONS OF THE EFFECT OF IONIZING RADIATION ON THE PHYSIOLOGICAL AND GENETIC BEHAVIOR OF VARIETIES OF GERMAN TOBACCO SEEDS. J. A. Schmid. Tabak-Forschung 2, No. 24, 77-83(1958) Apr. 25. (In German)

The artificial alteration of the genetic inheritance of the tobacco plant through the action of ionizing radiation was investigated. Elite seeds of Havana II-e, Burley E and Fo, and Virgin A and D were irradiated with γ rays of various dosages from a Co source, and the X_1 and X_2 generations were cultivated in field tests. The harvested plants were subjected to physiological, genetic, and chemical analyses in which the nicotine content and the resistance against various diseases of plants grown from irradiated seeds were determined. The germinating capacity and size of plants were reduced by increasing the dosages. The most important phenotypical manifestations of inheritable mutations were shown by some individuals of the X_2 generation in which darker leaf color and higher chlorophyll content were combined with greater resistance to vein browning disease. (OID)

15558

INDUCTION OF PHASE SHIFT IN CELLULAR RHYTHMICITY BY FAR ULTRAVIOLET AND ITS RESTORATION BY VISIBLE RADIANT ENERGY. Charles F. Ehret (Argonne National Lab., Lemont, Ill.). p.541-50 of "Photoperiodism and Related Phenomena in Plants and Animals." Washington, D. C., American Association for the Advancement of Science, 1959.

Phase shifts in cellular rhythmicity in Paramecium can be induced by low doses of far ultraviolet irradiation. Stages most sensitive to induction are the middle and late portions of the scotophilic phase. Phase-shift induction by UV is photoreversible by radiant energy from the visible region of the spectrum. (auth)

Radiation Sickness

15559 JPRS-L-893-N

PARENTERAL PROTEIN FEEDING IN RADIATION SICKNESS. N. F. Koshelev. Translated from Voprosy Pitaniya 18, No. 3, 36-40(1959). 10p. OTS.

Results of experiments with mice and rats indicate that parenteral nutrition, especially with the use of protein preparations, is contra-indicated in radiation sickness. Data are tabulated and results are discussed. (C.H.)

15560 JPRS-L-1842-D

COMPLEX THERAPY OF RADIATION SICKNESS DURING BLOOD LOSSES. M. Ya. Chaikovskaya (Chaykovskaya), O. S. Sergel', and G. N. Yelpat'evskaya (Yelpat'yevskaya). Translated from Vestnik Rentgenol. i Radiol. 34, No. 3, 47-52(1959). 11p. OTS.

The combined method used for treating radiation sickness complicated by blood losses, which consisted in using blood substitutes derived from heterogenous blood, antibiotics, and vitamins, exerted a positive effect on the course of acute radiation sickness. In experiments the blood substitutes parenterin and compound L-103 proved to be the most effective products in the treatment of radiation sickness, while the poorest results were obtained with Belenki's therapeutic serum. Folic acid, used together with vitamin B_{12}, helped to accelerate the regeneration of erythrocytes in irradiated animals. The treatment of leukopenia caused by radiation, with leukogen, gave good results. (auth)

15561

CHANGES IN THE KIDNEY FUNCTION AFTER LONG-TERM ACTION OF LOW DOSES OF IONIZING RADIATION. V. A. Ankudinov and E. D. Semiglazova (Central Inst. of Graduate Studies in Medicine, USSR). Med. Radiol. 5, No. 4, 3-6(1960) Apr. (In Russian)

Sixty patients with chronic radiation sickness of varying degree of severity were investigated for the detection of functional changes of the liver. The sugar content in the blood on a fasting stomach and the glycemic curve following the ingestion of 50 gm of glucose were determined; the content of bilirubin, cholesterol, residual nitrogen, and chlorides were readily separable from the iron. The Pytel-Quick test was performed. These investigations were repeated during the protracted examination of the patients. Data revealed that the function of the liver in patients with chronic radiation sickness is considerably impaired. The intensity of the functional changes of the liver corresponded with the severity of the disease. (auth)

15562

RESULTS OF DYNAMIC INVESTIGATION OF PERIPHERAL BLOOD IN SUBJECTS PROTRACTEDLY EXPOSED TO SMALL DOSES OF PENETRATING RADIATION. A. A. Danilin, N. I. Lukash, V. D. Serebryannikov, and G. A. Sheshina (Central Scientific-Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol. 5, No. 4, 7-14(1960) Apr. (In Russian)

A total of 451 persons engaged in activities involving all types of penetrating radiation were placed under dynamic surveillance. For comparison a parallel observation was arranged of a control group of 481 persons, not subject to any irradiation. The age, sex and vocational composition of both groups were analogous. No appreciable qualitative changes could be revealed in the formed blood elements in the subjects of either group. Most characteristic were the changes in the white blood cells, the end result of which was leucopenia. Its frequency among the persons of the group under investigation was 2 to 4 times greater than in the control group. Attempts to disclose typical alterations in the morphological composition of leucocytes remained unsuccessful, except for monocytosis, which was noted to be higher in the members of the first group. They also showed more frequent alterations in certain physico-chemical and fermentative properties of peripheral blood, which find their expression in the lengthening of the blood clot retraction and bleeding time. The chronic effect of small radiation doses revealed an indubitable relationship between the frequency and the degree of the above changes in the peripheral blood and in the work-record in the branches involving penetrating radiation. The disturbances revealed above were found to be partially reversible. (auth)

15563

CHANGES OF THE PULMONARY NERVOUS APPARATUS IN ACUTE RADIATION SICKNESS. V. B. Zairatyants (State Scientific-Research Inst. of Roentgen Radiology, USSR). Med. Radiol. 5, No. 4, 29-34(1960) Apr. (In Russian)

Changes in the nervous apparatus of the lungs in radiation sickness were studied. The early changes were found on the 3rd to 5th day following irradiation. They consisted of manifestations of irritation of nervous apparatus in the form of argyrophilia and appearance of varicose inflations along the nerve fibers, and destructive changes in the nerve cells of intrapulmonary nodes. The pathological processes revealed in the nervous apparatus were observed for a month after the irradiation. The most marked changes in the nerve elements were seen in the foci of hemorrhages and pneumonias. (auth)

15564

PATHOLOGICAL ANATOMY OF THE ACUTE AND SUB-ACUTE PHASE OF RADIATION SICKNESS IN ANIMALS DUE TO THE ACTION OF PRODUCTS OF URANIUM FISSION. A. A. Pinus and A. P. Novikova. Med. Radiol. 5, No. 4, 43-7(1960) Apr. (In Russian)

Pathomorphological and autoradiographic investigations were performed on cadavers of 276 perished or sacrificed animals subjected to the action of uranium fission products in different modes of introduction into the organism (intravenously, subcutaneously, with food, etc.). Upon the introduction of the radioactive substance, the animals lived from 1 to 120 days. It is shown that the changes in the acute and subacute phase of radiation sickness vary, depending upon the concentration of radioactive activity, the portals of entry, and the individual and species peculiarities, etc. In all modes of introduction into the organism, the products of uranium fission were predominantly and protractedly retained in the bones. (auth)

15565

A STUDY OF THE ERYTHROPOIETIC FACTOR OF THE STOMACH AND BLOOD IN ACUTE RADIATION SICKNESS. M. G. Kakhetelidze and L. S. Rogacheva (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 4, No. 10, 17-23(1959).

The serum of normal blood and the gastric juice of dogs were found to contain a hematopoietic-stimulating factor which was independent of vitamin B_{12}. Results are reported from a study of the influence of various doses of x radiation on the hematopoietic-stimulating factor. Twenty-four hours after irradiation with 300 r the erythropoietic-stimulating factor had disappeared from both gastric juice and blood serum. The significance of the findings on reaction mechanisms involved in radioinduced anemia is discussed. (C.H.)

15566

INVESTIGATION OF THE LEUCOCYTES OF THE PERIPHERAL BLOOD OF RABBITS WITH RADIATION SICKNESS BY SUPRAVITAL STAINING. V. A. Gubin. Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 4, No. 10, 24-8(1959).

Whole-body irradiation produced changes in the leukocytes of rabbits which were interpreted as the result of degenerative processes. Supravital staining techniques were used to demonstrate changes in morphology induced by radiation. (C.H.)

CHEMISTRY

General and Miscellaneous

15567 AECU-4662
Monsanto Chemical Co., Everett, Mass.
ORGANIC COOLANT RECLAMATION ANNUAL REPORT [FOR] DECEMBER 15, 1958 THROUGH DECEMBER 14, 1959. R. J. Wineman, J. S. Adams, B. J. Gudzinowicz, and D. A. Scola. Dec. 23, 1959. 141p. Contract AT(11-1)-705. OTS.

Methods for reclamation of high boiling polyphenyl degradation products were examined. In defining the chemistry involved in reclamation processes, model polyphenyl compounds such as o, m, and p-terphenyl, and p-quaterphenyl were used. Emphasis was placed on research in hydrocracking, redistribution (reaction with benzene), and partial reduction. Application of these techniques was examined in a preliminary study of a high boiler from Santowax-OM used in the OMRE. These methods show promise, however a detailed investigation is required to minimize carbon formation and to optimize operating conditions. (auth)

15568 HW-48914
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CONTINUOUS PLUTONIUM REDUCTION—PROCESSES RECOMMENDED FOR DEVELOPMENT. M. H. Curtis. Jan. 16, 1957. Decl. Apr. 28, 1960. 14p. Contract W-31-109-Eng-52. OTS.

Several continuous Pu reduction processes suitable for replacing batch reduction processes are listed in order of preference. Preference was given to processes utilizing lower temperatures, easily-handled reductants, and less corrosive halides. The requirement for maintaining a special reduction process atmosphere led to emphasis on conditions simplifying the continuous addition and removal of reactants. The selections favored those processes requiring a minimum of manipulation for feed preparation and by-product recovery operations. The most promising process utilizes electrodeposition of the trichloride at 700°C and gives a gaseous by-product that is recycled to the feed halogenation step for reuse. An alternate electrodeposition process for the trichloride produces the gaseous by-product as a waste stream and operates above 760°C, with the reduction atmosphere sealed from the halogenation atmosphere. The most promising metallic reduction utilizes lithium to reduce the tribromide at 680°C. (auth)

15569 NP-8697
Cincinnati. Univ. Research Foundation.
SOME 650 MDDPM PROGRAMS FOR THE CALCULATION OF VALENCE STATE ENERGIES. Progress Report No. I. H. H. Jaffé and Joseph Zung. Mar. 1960. 87p. Contract AF33(616)-6900.

Description is given of a program which was constructed using the SOAP II method for the IBM 650 MDDPM, to evaluate all the possible interactions between the valence shell electrons (both valence and non-valence electrons) of atoms. The classification of interacting electrons (valence shell electrons) is outlined and construction of the program is discussed. Other aspects of the program are described and detailed flow-charts are included. (J.R.D.)

15570 NP-8715
Celanese Chemical Co., Clarkwood, Tex.
THE SYNTHESIS AND EVALUATION OF AROMATIC ESTERS AS POTENTIAL BASE STOCK FLUIDS FOR GAS TURBINE ENGINE LUBRICANTS. Quarterly Progress Report No. 2 for February 1, 1960 to April 30, 1960. May 1, 1960. 47p. Contract AF33(616)-6786.

Research on the synthesis of trimesic acid (1, 3, 5 benzene tricarboxylic acid) derivatives and another structure based on trimethylalanisole (1-methoxy, 2,4,6-trimethylolbenzene) is reported. A general route for trimesic acid esters was found in the reaction between the desired hydroxyl compound and trimesoyl trichloride. This esterification route was used in the preparation of tribenzyl, triphenyl, tri-paracresyl, trixylenyl, and tris(2,2-dimethylamyl benzene) is reported in which a commercially available trimethylalphenol solution is used. This compound is processed through methylation with either dimethyl sulfate or menthyl iodide, followed by acetylation with acetic anhydride—pyridine, flashing and recrystallization. Most materials prepared thus far are either crystalline solids or pastes; however, a recent preparation of tris(2,2-dimethylamyl)trimesate was fluid at room temperature showing that suitable viscosity properties may be obtained in these classes of compounds. (J.R.D.)

15571 NP-8734
Hooker Chemical Corp., Niagara Falls, N. Y.
FLUORINE-CONTAINING CONDENSATION POLYMERS AND RESINS. Quarterly Progress Report No. 6 [for period] February 1, 1960 to May 1, 1960. David Knutson, John J. Kolano, Rudolf N. DeLeo, and Arthur M. Teller. May 15, 1960. 26p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: NEW CHEMICAL AND METHODS. Contract AF33(616)-5548.

Several fluorine-containing polyester laminating resins were prepared. Of the laminates prepared, the fluorinated glycol polyester laminates exhibited superior high temperature properties compared with the hydrocarbon glycol polyester laminates with one exception. Fluorinated and hydrocarbon laminates prepared with maleimide-triallyl cyanurate mixtures were compared by examining their flexural strengths at 260°C. A hexafluoropentanediol polyester cross linked with maleimide yielded a laminate that retained 95% of its initial 260°C flexural strength (39,900 psi) after aging 100 hr at 260°C. The flexural strengths of hydrocarbon laminates at 260°C after aging 100 hr exhibited low initial strengths (17,000 to 25,000 psi), became weaker after aging 8 to 25 hr (10,000 to 12,000 psi), and then became progressively stronger. The flexural strengths of laminates prepared from mixtures of triallyl cyanurate and maleimide were approximately the same at 260°C after aging 100 hr. Glass cloth laminates were prepared from perfluoroglutarimidine. These laminates exhibited low flexural strengths, but preliminary tests at 400 to 700°F indicated low weight losses and good retention of strength. (For preceding report see WADC-TR-55-221 (Pt.V).) (C.J.G.)

15572 NP-8774
Florida. Univ., Gainesville.
THE SYNTHESIS OF UNSATURATED FLUOROCARBONS. Quarterly Report 34 [for] September 13, 1959—December 13, 1959. Paul Tarrant, Ronald D. Richardson, David E. O'Connor, and Eugene C. Stump, Jr. 13p. Project No. 7-93-15-004. Contract DA-19-129-QM-500.

2-Perfluoroalkyl-substituted butadienes have been prepared where $R_f = CF_3$, C_2F_5, and C_3F_7. Four new fluorohalogenoethers are described. $CF_2 = CFMgBr$ was prepared. With carbonyl compounds, $CF_2 = CFMgBr$ gave products of the type $R'R''C = CFCOOH$. Two substituted bis(trifluoromethyl)benzenes were synthesized. (auth)

15573 ORO-265

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

THE EFFECT OF STRUCTURE ON THE REACTIVITY OF POLYFLUORO ORGANIC COMPOUNDS. Final Report. Jack Hine, Robert G. Ghirardelli, Robert Wiesboeck, Arthur D. Ketley, and O. Bertrand Ramsay. Mar. 31, 1960. 43p. Project No. B-115. Contract AT(40-1)-2084. OTS.

In a study of the effect of fluoro substituents, particularly polyfluoro, on reactivity and mechanisms of organic reactions, the formation of methylenes and carbanions, and elimination reaction were investigated. A study of the reactions of sodium thiophenoxide with organic iodides is described along with aspects of difluoroiodomethane reaction with base and on the formation of difluoromethylene. The kinetics of carbanion formation, as measured by deuterium exchange, was studied for various perfluoro compounds. These experiments are described along with experimental dehydrofluorination of other fluoroethanes. (J.R.D.)

15574 SCR-173

Sandia Corp., Albuquerque, N. Mex.

TRANSPARENT COLD-SHOCK-RESISTANT EPOXY CASTING RESIN. Ben Carroll and John Smatana. Apr. 1960. 34p. OTS.

The development of a transparent cold-shock-resistant epoxy casting resin is discussed. Physical and electrical properties are presented. A simple inexpensive test method for determining cold-shock-resistance is described. (auth)

15575 TID-5893

Ionics, Inc., Cambridge, Mass.

PROGRESS REPORT FOR PERIOD COVERING APRIL 15–MAY 15, 1960. Henry G. Petrow. May 18, 1960. 15p. Contract AT(30-1)-2470. OTS.

A thorium procedure is being developed, the main advantage of which is its rapidity. Reagents required and a stepwise procedure which represents the state of development are given. The procedure using Aliquat 336 for separation of radium from lead was modified. This procedure is described and data on radium yield are tabulated. (For preceding period see TID-5772.) (J.R.D.)

15576 UCRL-5861

California. Univ., Livermore. Lawrence Radiation Lab.

A NEW LIQUID EXPLOSIVE, NTN. Albert von Egidy, Milton Finger, Marion Hill, Donald Ornellas, Edward Ellison, and John Kury. Jan. 28, 1960. 12p. Contract W-7405-eng-48. OTS.

The preparation and properties of a new explosive, liquid over the range −65°F to +165°F, are presented. This explosive, called NTN, is a 5/1/1 mole ratio of nitromethane, tetranitromethane, 1-nitropropane. The sensitivity and stability properties of NTN meet military requirements. (auth)

15577 UCRL-9120

California. Univ., Berkeley. Lawrence Radiation Lab.

ELECTRICAL PROPERTIES OF ORGANIC SOLIDS. I. KINETICS AND MECHANISM OF PHOTOCONDUCTIVITY OF METAL-FREE PHTHALOCYANINE. II. EFFECTS OF ADDED ELECTRON ACCEPTORS AND DONORS (thesis). David R. Kearns. Mar. 25, 1960. 121p. Contract W-7405-eng-48. OTS.

Techniques involving the use of high-intensity, short-duration light pulses were applied to the study of the kinetics of photoconductivity in films of metal-free phthalocyanine. These experiments, in conjunction with measurements of steady-state photoconductivity indicate that the principal route for the formation of charge carriers is via the first excited singlet state of phthalocyanine, although the lowest triplet state can to some extent contribute to charge-carrier production. Consistent with a variety of steady-state and kinetic conductivity measurements, a mechanism is proposed for the ionization of the excited states of phthalocyanine to form charge carriers. This mechanism is strongly supported by the studies of the effects of electron acceptors and donors on the electrical properties of phthalocyanine. A method was developed to measure the diffusivity and mobility of the majority charge carrier. Such measurements lead to a room-temperature value of $\sim 10^{-3}$ $cm^2/v\text{-}sec$ for the mobility of positive-charge carriers (holes) in phthalocyanine. An interpretation of the kinetics of flash-photoconductivity decay suggested that the mobility of charge carriers is concentration-dependent, being lower at high carrier concentration. The decay of the photocurrent is suggested to be the result of a diffusion-limited bimolecular recombination of electrons and holes, with a recombination radius of approximately one molecular diameter. (auth)

15578 WADD-TR-60-283

General Electric Co. General Engineering Lab., Schenectady, N. Y.

EVALUATION OF EXPERIMENTAL POLYMERS. Period covered: March 1959 to March 1960. Charles D. Doyle. May 1960. 117p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: NEW CHEMICALS AND METHODS. Contract AF33(616)-5576.

Thermogravimetric analysis (TGA) in dry N_2 is considered in detail as a method for comparing the intrinsic thermal stabilities of experimental polymers on both empirical and fundamental grounds. Two procedural decomposition temperatures are defined and discussed. One is based on the locations of recognizable curve features, while the second is based on areas under the curve. Kinetic analysis of volatilization data is discussed on the basis of both the Arrhenius rate equation and its integral. Two quasi-kinetic methods are discussed, one based on empirical time-temperature superposition; the other, on an empirical relationship between isothermal times and temperatures in TGA. Two corroborative test methods, differential thermal analysis and thermoparticulate analysis, are discussed briefly. (auth)

15579 JPRS-2634

ON THE EFFECT OF THE CHARGE OF THE SUBSTANCE AND THE DIELECTRIC CONSTANT OF THE SOLVENT UPON THE VELOCITY OF HYDROGEN EXCHANGE. A. I. Shatenshtein (Shatenstein) and E. (Ye.) A. Yakovleva. Translated from Doklady Akad. Nauk S.S.S.R. 105, 1024-7(1955). 8p. OTS.

Experiments are described in which the velocity of hydrogen exchange in salts of acetic acid was measured. Hydrogen exchange in the CH_3-group of the acetate was measured using heavy water, deuterated ammonia, and deuterated hydrazine each of which differed from the others in protophilic values and dielectric constants. (J.R.D.)

15580 UCRL-Trans-536

USE OF ANION EXCHANGERS IN ANALYTICAL CHEMISTRY. I. SORPTION OF CHLORIDE COMPLEXES OF CERTAIN METALS IN OAL ANION EXCHANGERS. Karel Liška and Ladislav Klír. Translated from Chem. listy 51, 1467-70(1957). 4p. JCL or LC.

Measurements were made of the elution constants of chloride complexes of Ni, Mn, As, Co, Cu, Zn, Fe, Pb, Cd, Bi, and Sn in a strongly basic ion exchanger. (C.J.G.)

15581

REVERSIBLE AND IRREVERSIBLE PROCESSES IN THE DROPPING MERCURY ELECTRODE. IX. La^{3+} AND Ce^{3+}. J. Sancho and V. Almagro (Facultad de Ciencias, Murcia, Spain and Instituto Rocasolano del C.S.I.C., Murcia, Spain). Anales real soc. españ. fís. y quím. (Madrid), Ser. B 56, 115-22(1960) Feb. (In Spanish)

A study of La^{3+} and Ce^{3+} ions in solutions LiCl 0.1 M; $BrN(CH_3)_4$ 0.1 M; LiCl 0.1 M—50% ethyl alcohol; $CaBr_2$ 0.1 M—ethyl alcohol 50%; KCl 0.1 M—ethyl alcohol 50%; $MgCl_2$ 0.1 M—50% ethyl alcohol; and LiCl 0.1 M—80% ethyl alcohol was carried out. In all cases one polarographic wave was found, due to an irreversible process governed by diffusion. By using the Ilkovic equation and microcoulombic methods, it was determined that the number of electrons taking part in the electrochemical transfer is three. The reduction of La^{3+} and Ce^{3+} takes place, in the conditions herein studied, in one only stage $M^{3+} \rightarrow M^0$. Interesting data for the use of these polarographic waves for analytical purposes are presented. (auth)

15582

THE INFRARED SPECTRA OF SOME URANYL COMPOUNDS. G. L. Caldow, A. B. Van Cleave, and R. L. Eager (Univ. of Saskatchewan, Saskatoon). Can. J. Chem. 38, 772-82(1960) June.

The infrared spectra for the di- and hexa-hydrates of uranyl nitrate, for anhydrous uranyl acetate, and for sodium zinc uranyl acetate hexahydrate were obtained using the potassium bromide pressed disk technique. Where possible, samples were prepared by freeze-drying aqueous solutions of the appropriate compound and potassium bromide. The uranyl nitrate hydrates gave spectra with peaks characteristic of both nitrate and nitrato groups. For uranyl acetate the type of spectra obtained depended upon the ratio of uranyl acetate to potassium bromide in the freeze-dried mixture. It is postulated that, for relatively large ratios of uranyl acetate to potassium bromide, the carbonyl oxygen atoms of the acetate groups are chelated to the uranium atom. The spectrum of sodium zinc uranyl acetate hexa-hydrate is quite similar to that reported by Jones for sodium uranyl acetate. Using the 933 cm^{-1} peak, the Beer-Lambert law was obeyed for samples prepared by freeze-drying solutions containing uranyl nitrate and potassium bromide. (auth)

15583

COMPLEXONE. XXXII. THE 1:2 COMPLEXES OF THE CATIONS OF THE RARE EARTHS WITH NITRILOTRIACETATE (NTE). G. Anderegg (Eidgenössische Technische Hochschule, Zurich). Helv. Chim. Acta 43, 825-30(1960). (In German)

The anion of nitrilotriacetic acid is capable of forming 1:2 complexes as well as 1:1 complexes with the cations of the rare earth metals. The 1:1 complexes have stability constants of the order of magnitude of 10^{11} which increase slightly but steadily from La^{3+} to Lu^{3+}. The constants K_2 of the 1:2 complexes on the other hand increase from $10^{7.37}$ for La^{3+} to $10^{9.35}$ for Gd^{3+}; this strong increase for the first half of the series of the rare earth metals is followed by a slight decrease for the second half of the series. (auth)

15584

SUBSTITUTION REACTIONS OF PLATINUM(IV) COMPLEXES. THE SYNTHESIS AND PROPERTIES OF TRANS-DITHIOCYANATO-BIS-(ETHYLENEDIAMINE) PLATINUM(IV) SALTS. R. C. Johnson and F. Basolo (Northwestern Univ., Evanston, Ill.). J. Inorg. & Nuclear Chem. 13, 36-43(1960) Apr. (In English)

Substitution reactions of trans-$Pt(en)_2Cl_2^{2+}$ with several different reagents are reported. A description is given of what is believed to be the first synthesis of trans-$Pt(en)_2(SCN)_2^{2+}$ salts. The properties and possible structure of this complex are discussed. (auth)

15585

FREQUENCY SHIFTS IN URANYL SALTS ON DEUTERATION. D. N. Pande (D.S.B. Government College, Naini Tal, India). J. Sci. Ind. Research (India) 19B, 73-4(1960) Feb. (In English)

The results of a study of the frequency shifts in the fluorescence spectra of various uranyl salt hydrates upon deuteration are reported. Three distinct kinds of shifts were found for $UO_2SO_4 \cdot 3H_2O$: (1) most of the bands shift by 8 to 12 cm^{-1}, (2) some shift by a larger amount (ca. 16 cm^{-1}), and (3) others do not show any appreciable shift. Data on the shifts in $UO_2SO_4 \cdot 3H_2O$ are given for both fluorescence and absorption spectra. The results for other salts were: $UO_2SO_4 \cdot 4H_2O$, $UO_2(ClO_4)_2 \cdot 4H_2O$, and $K_2UO_2Cl_4 \cdot 2H_2O$ show differential shifts, while $UO_2Cl_2 \cdot 3H_2O$ and $UO_2(CH_3COO)_2 \cdot 2H_2O$ show only small shifts on the order of 4 to 6 cm^{-1}. (D.L.C.)

15586

THE HALF STAGE POTENTIAL OF PROMETHIUM. K. Schwabe and G. Anders (Zentralinstitut für Kernphysik, Rossendorf bei Dresden). Naturwissenschaften 47, 201 (1960). (In German)

A promethium preparation (Pm^{147}) containing Sm^{147} and Ce^{144} was purified chromatographically. The polarographic potential was determined using potassium chloride and tetrabutyl ammonium iodide as electrolytes. The Pm was in the form of sulfate. The half-stage potential in the iodide was measured at -1.52 ± 0.015 v with respect to the standard hydrogen electrode at 25°C. In the potassium chloride it was –1.61 v. The variation is probably caused by complex formation with the chloride. (J.S.R.)

15587

DETERMINATION OF U—O BOND DISTANCE IN URANYL COMPLEXES FROM THEIR INFRARED SPECTRA. L. H. Jones (Los Alamos Scientific Lab., N. Mex.). Spectrochim. Acta No. 6, 409-11(1959) July.

From the U—O bond force constant and U—O bond distance (infrared spectra) in $K_3UO_2F_5$ the constant was calculated for use with Badger's rule. It is shown that this relation ($R_{UO} = 1.08\ F_{UO}^{-1/3} + 1.17$) gives good agreement when applied to $NaUO_2(Ac)_3$. R is in angstroms and F in millidynes per angstrom. The other known cases (UO_2CO_3 and $MgUO_2O_2$) are in agreement, but the limits of error involved are too great to allow further confirmation of the relation. It is shown that the observation of the two vibrational frequencies, ν_3 and $\nu_1 + \nu_3$, of the uranyl group should serve as a very sensitive measure of the U—O bond distance. (auth)

15588

THE INFRARED SPECTRA OF DEUTERATED TETRAHYDROFURANS. A. Palm and E. R. Bissell (Univ. of California, Livermore). Spectrochim. Acta 16, 459-66 (1960) May.

The infrared spectra of a series of deuterated tetrahydrofurans were studied in the gaseous, liquid, and solid states in the region between 3200 and 350 cm^{-1}. An attempt was made to assign the observed absorption bands to the normal modes of vibration, taking advantage of isotopic shifts and effects due to phase changes. The spectra of the liquid compounds show the usual displacements com-

pared with those of the vapors; the solid-state spectra are intensified and reveal a sharpening and splitting of the absorption bands. A number of peaks in the region between 1400 and 700 cm^{-1} possess appreciable fine structure in the crystalline state. (auth)

15589

N^{15} ISOTOPE EFFECTS ON THE VIBRATIONAL FREQUENCIES OF ANILINE AND ASSIGNMENTS OF THE FREQUENCIES OF ITS NH_2 GROUP. M. Tsuboi (Tokyo Univ.). Spectrochim. Acta 16, 505-12(1960) May.

Infrared absorptions of aniline in which 31.9% of nitrogen is N^{15} and 68.1% is N^{14} were examined in dilute CCl_4 and CS_2 solutions by means of a grating instrument. For five bands at 3481.4, 3395.2, 1618.9, 1276.1, and 1114.6 cm^{-1} appreciable isotope shifts were observed. It was shown that these bands are to be assigned, respectively, to NH_2 antisymmetric stretching, NH_2 symmetric stretching, NH_2 bending, C–N stretching and NH_2 rocking (or twisting) vibrations. (auth)

15590

THE USE OF NITROGEN-15 FOR THE CHARACTERIZATION OF INFRARED BANDS ARISING FROM NITROGEN VIBRATIONS. Linsley S. Gray, Jr., Velmer A. Fassel, and Richard N. Kniseley (Ames Lab., Ames, Iowa). Spectrochim. Acta 16, 514-17(1960) May.

The results of the study of the effect of N^{15} substitution for N^{14} in the infrared spectra of (1) n-hexyl nitrite, (2) benzenediazonium chloride, and (3) p-N,N-dimethylaminoazobenzene are given. (1) and (3) were studied in CCl_4, CS_2, and n-hexanol, while (2) was studied as KBr disks. Tables of the frequencies and interpretations in terms of nitrogen vibration modes are presented. The effects of cis-trans configuration are discussed for (1) and (3). (D.L.C.)

15591

POLARIZATION OF HYDROGEN NUCLEI IN FREE RADICAL. G. S. Lomkatsi. Zhur. Eksptl'. i Teoret. Fiz. 38, 635-6(1960) Feb. (In Russian)

The polarization of hydrogen nuclei in DPPH (diphenylpicrylhydrazil) was studied at liquid helium temperature. Three mutually perpendicular magnetic fields were imposed on the specimen cooled to 4°K. The nuclear resonance signal was plotted as a function of the constant field. It was observed that in addition to inducing proton polarization in its own molecule the nonevaporated electrons of the DRRN molecule can induce proton polarization in distant molecules. (R.V.J.)

15592

CONDENSED STATE REACTIONS AND PHASE EQUILIBRIA. Alan W. Searcy (Univ. of California, Berkeley). p.157-68 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A discussion centering around solution phenomena in condensed-phase chemistry with the emphasis on solution phenomena in solid phases of relatively narrow composition limits is presented. The value of treating all condensed phases as solutions is demonstrated. (J.R.D.)

15593

HIGH TEMPERATURE CHEMICAL SYNTHESIS. Russell C. Phillips and F. Alan Ferguson (Stanford Research Inst., Menlo Park, Calif.). p.192-7 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A discussion of reactions, mostly gas-phase at tempera tures above 3000°K, for chemical synthesis is presented. Impediments to high-temperature chemical synthesis are examined, and predictions of future developments are outlined. (J.R.D.)

15594

International Atomic Energy Agency, Vienna.
TRITIUM: DOSAGE, PRÉPARATION DE MOLÉCULES MARQUÉES ET APPLICATIONS BIOLOGIQUES. (Tritium: Determination, Preparation of Labeled Molecules and Biological Applications). Walter G. Verly. Review Series. Developments in the Peaceful Applications of Nuclear Energy, No. 2. 1960. 56p. $1.00.

Of the different methods used for assaying tritium, liquid scintillation and gas counting are the most useful. The different ways of preparing tritiated compounds, biological and chemical, syntheses and exchanges, are described. In a few biological experiments, tritium has been used to trace the fate of hydrogen atoms; more often, it was a label for a whole molecule or part of it. In the latter case, its superiority to C^{14} rests on the ease of tritiated compounds preparation by exchange, on the higher specific activities attainable and on the low cost of the isotope. Isotope selection may occur and disturb the experimental results; but it can also be used to detect new biochemical pathways. At the cellular level, tritium yields the most precise autoradiograms because of the low energy of its β radiation; using specific labeled precursors is a means of studying the biochemistry of a single cell. The possible utilization of tritium in radiotherapy and the hazards involved by absorption of the isotope are discussed. (auth)

15595

METHOD OF DISSOLVING URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 834,530. May 11, 1960.

A process is given for dissolving irradiated U. Concentrated boiling HNO_3 is used in one example, 92% HNO_3 giving best results. (T.R.H.)

Analytical Procedures

15596 APEX-431(Del.)
National Spectrographic Labs., Inc., Cleveland.
FINAL PROGRESS REPORT—AUGUST 15, 1956 THROUGH TERMINATION ON AUGUST 30, 1958. L. E. Zeeb, J. T. Rozsa, D. C. Manning, and J. Stone. Oct. 10, 1958. Decl. with deletions Feb. 17, 1960. 77p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33 (600)-38062 and AT(11-1)-171. Subcontract AT-63 and Amendments No. 1, 2, 3, and 4. OTS.

A detailed discussion of the development project for trace analysis of yttrium metal and oxide is presented. Three routine methods are described, and remarks on zirconium and scandium determination in ore are included. Information on results of development of trace analytical methods for chromium metal, beryllium oxide, uranium isotopic content, and zirconium metal is also included along with routine determination methods for these materials. (J.R.D.)

15597 CF-59-7-128
Oak Ridge National Lab., Tenn.
DETERMINATION OF OXYGEN IN OXIDE FILMS BY NEUTRON ACTIVATION ANALYSIS. J. W. Winchester, R. E. Meyer, L. C. Bate, and G. W. Leddicotte. July 15, 1959. 6p. Contract [W-7405-eng-26]. OTS.

Preliminary experiments were conducted to evaluate the use of the nuclear reactions $Li^6(n,\alpha)H^3$ and $O^{16}(H^3,n)F^{18}$ to determine the thickness of oxide films on metals. Sheets of thin paper and of aluminum, imbedded in powdered LiF, were irradiated with pile neutrons at a flux of 6×10^{11} n/cm^2/sec and counted with an end-window proportional counter. A saturation activity of 1.87 hr F^{18} of 150 dis/min per microgram of oxygen was observed in the paper, but radioactivity due to impurities masked F^{18} in the aluminum. It is concluded that a 1 A (0.01 μgm/cm^2) oxide film thickness may be measured by a neutron irradiation at a flux of 10^{14} n/cm^2/sec but chemical separation of induced radioactivity from the bulk metal is essential. (auth)

15598 CF-60-3-158
Oak Ridge National Lab., Tenn.
RARE EARTH CHROMATOGRAPHY USING BIS(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID. John W. Winchester. Mar. 14, 1960. 9p. OTS.

Several techniques of column construction were tested for the chromatographic separation of the rare earths using bis(2-ethylhexyl)orthophosphoric acid (HDEHP). Earlier work, which showed that rare-earth separations can be made by HDEHP supported on an aluminum oxide column and elution with hydrochloric acid, was continued in order to develop a procedure for rare-earth chromatography in connection with neutron activation analysis. Three column techniques show promise, according to initial tests. (auth)

15599 HW-21718
Hanford Works, Richland, Wash.
EMISSION SPECTROSCOPIC ANALYSIS OF HYDROGEN–DEUTERIUM MIXTURES. J. A. Parodi, W. G. Burch, L. F. Kendall, and M. B. Leboeuf. July 30, 1951. Decl. May 5, 1960. 29p. Contract W-31-109-Eng-52. OTS.

An emission spectrometer procedure relating the intensities of Balmer lines to the relative concentrations of H and D was calibrated for low flow rates. Isobars of true vs. apparent composition are given for the composition range of 89 to 100% D_2 and for pressures of 700, 800, 900, and 1000 μ. Experiments revealed that, with the preparation of similar calibration curves, the accurate analysis of $H_2 - T_2$ mixtures could be carried out by the emission spectrometer method. (W.L.H.)

15600 ISC-984
Ames Lab., Ames, Iowa.
RECENT DEVELOPMENTS IN THE ANALYTICAL CHEMISTRY OF THORIUM AND ITS COMPOUNDS. Charles V. Banks. Feb. 1958. 54p. Contract W-7405-eng-82. OTS.

A review is given of the organic compounds used in the determination of thorium. Thorium separation by extractions, paper chromatography, selective absorption, gravimetric, titrimetric and polarographic methods, and ion exchange are reviewed. (C.J.G.)

15601 NP-8653
Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas.
PAPER CHROMATOGRAPHY OF INORGANIC IONS IN NITRATE MEDIA. II. SEPARATION OF Se–Te–Po AND RaD–RaE–Po. M. C. Levi and J. Danon. 1959. 5p. (Notas de Física Vol. V, No. 15).

A paper chromatographic method is presented for the separation of mixtures of Bi^{210}, Pb^{210}, Po, Se, and Te in nitric acid solution. The solvent is a butanol-propanol mixture. Addition of lithium nitrate to the nitric acid solution to be separated results in improved separation of Po from the other elements. (D.L.C.)

15602 WADC-TR-59-325
Ledoux and Co., Teaneck, N. J.
ION EXCHANGE AND OTHER CHEMICAL METHODS FOR BERYLLIUM BASE ALLOYS. Period covered: May 1958 to May 1959. Silve Kallmann, Robert Liu, and Hans Oberthin. May 15, 1959. 39p. Project No. 7364. Contract AF33(616)-5743. (PB-161295). OTS.

Procedures are described for both cation and anion exchange resins which allow the determination of all elements present in beryllium alloys in successive steps using one sample portion. The elements covered in the range of 0.1 to 10% are copper, aluminum, iron, nickel, cobalt, cerium, silver, gold, and palladium. (auth)

15603
POLAROGRAPHIC DETERMINATION OF TECHNETIUM AND RUTHENIUM RADIONUCLIDES IN FISSION PRODUCTS. Daniel L. Love and Allen E. Greendale (U. S. Naval Radiological Defense Lab., San Francisco). Anal. Chem. 32, 780-6(1960) June.

A rapid method using polarographic techniques has been developed for the determination of technetium-99m and ruthenium-103,106 radionuclides in fission product mixtures. A known fraction of the technetium and ruthenium radionuclides is selectively reduced at the dropping mercury electrode to an oxidation state soluble in mercury, and the resulting amalgam is removed from the fission-product solution by falling into carbon tetrachloride. An assay of the separated radionuclides is made by gamma-counting the amalgam. The precision obtained for technetium-99m is within about 1%, the accuracy agreed with the radiochemical procedure (for molybdenum-99) within 2%, and the decontamination factor from other fission products is about 10^5. A single separation requires about 3 minutes; if enough activity is present, only a few seconds. The rapidity of the entire procedure (including calculation of the number of fissions) is illustrated by the fact that 50 analyses can be completed in 1 day by two people. (auth)

15604
DETERMINATION OF OXYGEN IN YTTRIUM FLUORIDE BY A VACUUM DISTILLATION TECHNIQUE. Virginia M. Horrigan, Velmer A. Fassel, and John W. Goetzinger (Ames Lab., Ames, Iowa). Anal. Chem. 32, 787-9(1960) June.

A conventional vacuum fusion gas analysis unit is used for the determination of oxygen in yttrium fluoride. The yttrium fluoride is distilled from the furnace, leaving the less volatile oxygen-containing compounds to be reduced by the carbon crucible. Recoveries of oxygen are quantitative when a liquid reaction medium is provided for the reduction. The effect of platinum as the bath medium on the rate of carbon monoxide evolution is discussed. (auth)

15605
SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH BENZOHYDROXAMIC ACID IN 1-HEXANOL. Clifton E. Meloan, Paul Holkeboer, and Warren W. Brandt (Purdue Univ., Lafayette, Ind.). Anal. Chem. 32, 791-3 (1960) June.

A spectrophotometric method for quantitatively determining small amounts of uranium is based on extraction with 1-hexanol of the colored product formed when the uranyl ion reacts with benzohydroxamic acid ($C_6H_5CONHOH$) at pH 6.2. The system obeys Beer's law between 7×10^{-7} and 2×10^{-5} mole of uranyl ion when extracted into 10 ml. of 1-hexanol. The effects of reagent-metal ratio, pH, diverse ions, extraction interferences, and reagent stabilities have been investigated. The stoichiometry of the

colored species was determined to be 1 to 1 (uranium–benzohydroxamic acid) at pH 3.5 and 1 to 2 at pH values more basic than 5.5. The interference caused by thorium(IV) and cerium(III) is eliminated. (auth)

15606

DETERMINATION OF ACTIVE HYDROGEN USING EXCHANGE WITH DEUTERIUM. INFRARED SPECTROPHOTOMETRIC METHOD. William R. Harp, Jr. (Shell Development Co., Emeryville, Calif.) and Robert C. Eiffert (Shell Oil Co., Martinez, Calif.). Anal. Chem. 32, 794-6 (1960) June.

A generalized infrared method for the determination of active hydrogen involves exchanging the active hydrogen in the sample with deuterium of D_2O. The sample is mixed with a relatively large amount of D_2O and the amount of active hydrogen calculated according to the method of Gaunt from the intensity of the 2.97-micron OH band generated in the D_2O. Water-soluble or insoluble samples may be run in about ½ hour with an accuracy to about 2% of the amount of active hydrogen present. (auth)

15607

SPECTROPHOTOMETRIC DETERMINATION OF FLUORIDE WITH THORIUM CHLORANILATE. A. L. Hensley and J. E. Barney, II (Standard Oil Co. of Indiana, Whiting). Anal. Chem. 32, 828-31(1960) June.

A new spectrophotometric method for determining fluoride is based on the reaction with thorium chloranilate in aqueous methyl Cellosolve, buffered at pH 4.5. Sensitivity is varied by measuring absorbance at either 540 or 330 mμ, and by varying the amount of methyl Cellosolve in the solvent. The method has been tested by analyzing waters and catalysts. Most of the common anions do not interfere, and many of those that do can be removed with ion exchange resins. The new method is as sensitive as widely used colorimetric methods based on the bleaching of a complex by fluoride ion; in addition, a wide concentration range may be covered and frequent recalibration is not required. (auth)

15608

ZIRCONYL-ALIZARIN CHELATE IN SPECTROPHOTOMETRIC DETERMINATION OF TRACE AMOUNTS OF FLUORINE. R. P. Ashley (Aluminium Labs., Ltd., Arvida, Quebec). Anal. Chem. 32, 834-6(1960) June.

The preliminary separation of the fluoride ion from fluoride-bearing materials by the Willard-Winter steam distillation invariably yields a distillate which is slightly contaminated with the acid used for the distillation. This free acid is an undesirable feature of absorptiometric procedures requiring precise control of pH. A simplified method for the determination of microgram quantities of the fluoride ion involving a zirconium–sodium alizarin sulfonate reagent is presented. Good precision and accuracy are obtained without the tedium of pH adjustment, and adequate sensitivity coupled with strict observance of the Beer-Lambert law in the fluoride range 0 to 1.9 γ per ml. makes possible the precise measurement of concentrations of the order of 0.05 γ per ml. (auth)

15609

REMOVAL OF MOLYBDENUM IN ANALYSIS OF URANYL AND OTHER PHOSPHATES. A. H. Volborth (Univ. of Nevada, Reno). Anal. Chem. 32, 882-3(1960) June.

With modifications of the universally used hydrogen sulfide method for the removal of Mo some complex phosphate minerals can be completely analyzed faster and with smaller samples than before. Several complete phosphate analyses were performed using this method with satisfactory results. (W.L.H.)

15610

FILTER PAPER OXIDATION. Edward L. Lee and Donald L. Seaton (Univ. of California, Livermore). Anal. Chem. 32, 889-90(1960) June.

A method for the separation of radioactive particulate matter produced in a nuclear explosion from the filter medium on which the samples were collected is investigated. The filters used were pure cellulose paper reinforced with a cloth scrim and impregnated with stearic acid. Two methods were proposed: use of sonics to dislodge the particles from the paper, and removal of the paper from the particles with some form of active oxygen. It is the second of these two possibilities that is discussed. (W.L.H.)

15611

SOLENOID-OPERATED GAS SAMPLER FOR USE IN GAS CHROMATOGRAPHY. Richard C. Palmer, D. Keith Davis, and W. Van Willis (Georgia Inst. of Tech., Atlanta). Anal. Chem. 32, 894-5(1960) June.

An electrically operated sampler was devised for injecting gas sample into the chromatographic units. The electrically operated system is composed of two two-way and two three-way solenoid valves which are operated by a direct current power supply. The valves employed are rated at pressures up to 1000 psi and a vacuum down to 5 microns. (W.L.H.)

15612

MASS SPECTROMETRY AND THE IDENTIFICATION OF TECHNETIUM. G. M. Kukavadze, R. N. Ivanov, V. P. Meshcheryakov, Yu. G. Sevast'yanov, B. S. Kir'yanov, V. I. Galkov, and A. P. Smirnov-Averin. Atomnaya Energ. 8, 365-7(1960) Apr. (In Russian)

A method for the mass spectrographic analysis of technetium was developed. The method employs a 60° mass spectrometer with a chamber bent along a 150-mm radius. The thermion source, based on the principle of surface ionization by incandescent tungsten emitters, was coated with a 0.1-μ layer of iridium. Aqueous solutions of ammonium pertechnetate were placed on the emitter and reduced to metal by heating. The ion source with the specimen was placed in the mass spectrometer where technetium ions appeared as Tc^+ at 1600 to 1800°C. The mass spectrogram of technetium and rubidium is plotted. The suggested method combined with an isotopic dilution method is capable of quantitative determinations of technetium and some of its compounds. (R.V.J.)

15613

DETERMINATION OF THORIUM PRESENT IN FLUORIDE SALT MIXTURES. R. F. Apple and J. C. White (Oak Ridge National Lab., Tenn.). Chemist Analyst 49, 42-3(1960) June.

Three analytical procedures using EDTA titrations are developed for the determination of thorium in (1) fluoride salt mixtures, (2) fluoride salt mixtures containing cerium, and (3) fluoride salt mixtures containing only a micro amount of thorium. In (1) and (2), fluoride is removed as BF_3; in (1) and (3), back-titration of excess EDTA with copper(II) solution is employed to counteract the effect of high salt concentrations, while direct titration with EDTA is used after extraction of thorium from cerium with trioctylphosphine oxide and subsequent back-extraction with 0.3 M H_2SO_4. In all cases, xylenol orange is used as an indicator for the titrations, and coefficients of variation of 0.8 to 1.3% are obtained. (D.L.C.)

15614

ANALYSIS AND ANALYTICAL CONTROL IN NUCLEAR ENERGY. APPLICATION TO THE ANALYSIS OF URANIUM. J. Artaud (Centre d'Études Nucléaires, Saclay,

France). Énergie nucléaire 2, 93-104(1960) Mar.-Apr. (In French)

The methods used for the spectrographic analysis of uranium are reviewed critically. The Scribner and Mullin method, analysis by fractional distillation in a continuous arc with carrier, is discussed in detail. (tr-auth)

15615

INVESTIGATIONS ON THE OBTENTION, SEPARATION, AND THE PURIFICATION OF TANTALUM AND NIOBIUM, ESPECIALLY BY ELECTROLYTIC METHODS. I. DETERMINATION OF Ta AND Nb BY MEANS OF RADIOISOTOPES OF THESE ELEMENTS. Ph. Grandjean, P. Lerch, and R. Monnier (Université, Geneva). Helv. Chim. Acta 43, 848-52(1960). (In French)

Two radiochemical methods for the quantitative determination of tantalum and niobium, with the aid of Ta^{182} and Nb^{95}, are described. If only one of these radioisotopes is present, it can be determined by counting the gamma radiation emitted in a well-crystal scintillator. The simultaneous determination of both Ta and Nb is possible by the interpretation of the entire spectrum obtained in the presence of both radioisotopes. (auth)

15616

PROCESS MONITOR USING HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE. Forrest A. Nelson (Varian Associates, Palo Alto, Calif.) and Charles A. Reilly and William E. Savage (Shell Development Co., Emeryville, Calif.). Ind. Eng. Chem. 52, 487-9(1960) June.

Because there was no method available for rapid analysis of liquid in a specific process except high-resolution nuclear magnetic resonance (NMR), a special NMR instrument was developed to operate directly on the process stream. The equipment measured and recorded the ratio of two compounds each 6 seconds. Automatic alarms warned of wrong ratio or equipment malfunction. High-resolution NMR, especially with the improvements of the past few years, is capable of giving fast, accurate, and nondestructive analysis of compounds in many process streams. The performance of this instrument has shown that such equipment is now practical for use as either a process monitor or a process control device. (auth)

15617

CONTRIBUTION TO ANALYSIS OF ALKALI METALS. [PART] I. H. Koch (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie 3, 315-20(1960) Apr. (In German)

By using light isotopes, the techniques of separating the alkali metals are checked. The chloroplatinic, perchlorate, and kalignost methods do not give satisfactory analytical results. Also, in regions where apparently good values are obtained, satisfactory separations of the different alkali metals are not possible. This is true also for Na–Li separations with amyl alcohol, isopropyl alcohol, and ether–alcohol–HCl mixtures. None of these methods give adequate results and are not useful for separating mixtures which contain isotopes of alkali metals. By isotopic dilution analysis Na can be determined in alkali metal mixtures in a simple manner. Also, in complex materials an exact quantitative Na determination is possible. Even sodium impurities in KOH or KCl below 10% can be determined. As a result of this highly simplified and accurate separation process, Na determination by isotope dilution is very useful as a rapid method and in industrial serial analyses as in the potassium industry. (tr-auth)

15618

QUANTITATIVE DETERMINATION OF POTASSIUM BY MEASURING THE β ACTIVITY OF K^{40}. M. Rösseler. Kernenergie 3, 388-90(1960) Apr. (In German)

The K_2O content of solid samples can be determined in 20 to 60 min with an accuracy of $\pm 0.6\%$ K_2O by β activity measurement. A VA-Z-410 GM immersion tube was used in a chamber shielded against cosmic rays. By measuring the region of the saturation thickness, only a single weighing is necessary. The other salts in the samples used had a negligible effect on the results. For each measurement the material must be ground to a uniform grain size to avoid errors. (T.R.H.)

15619

GAMMA-RAY SCINTILLATION SPECTROMETER IN USE FOR SIMULTANEOUS ESTIMATION OF THE CONCENTRATION OF URANIUM, THORIUM, AND POTASSIUM IN SPECIMENS OF ROCKS AND SOILS. Stanisława Zmysłowska (Inst. of Isotope Studies, Polish Academy of Sciences, Warsaw). Nukleonika 4, 625-38(1959). (In Polish)

A method is reported for the simultaneous estimation of the concentration of radioactive isotopes in soils with nuclear plates and G-M counters. There was a discussion on work done with the method of the gamma-ray spectrometer giving the distribution of scintillation spectra of the gamma-rays of the uranium, thorium, and potassium-40. The enclosed tables give the results obtained for concentrations of the uranium, thorium, and potassium in rocks and soils. The conclusions regard the usefulness of gamma-ray scintillation spectrometers for these purposes. (auth)

15620

DEUTERIUM ANALYSIS–A SIMPLE AND PRECISE METHOD. Edward M. Arnett, Michael Strem, Norburt Hepfinger, Jonathan Lipowitz, and David McGuire (Univ. of Pittsburgh). Science 131, 1680-1(1960) June 3.

By means of reaction with calcium hydride in a generator of simple design, the water samples are converted into H_2 and HD. With hydrogen as carrier gas, the greater thermal conductivity of HD produces a peak whose size is linearly related to the deuterium content of the original water. (auth)

15621

EMISSION SPECTROMETRIC DETERMINATION OF THE GASEOUS ELEMENTS IN METALS. VI. OXYGEN IN VANADIUM. V. A. Fassel and L. L. Altpeter (Ames Lab., Ames, Iowa). Spectrochim. Acta 16, 443-9(1960) May.

The oxygen impurity content of vanadium metal can be determined spectrometrically by liberating it as carbon monoxide with a d-c carbon-arc discharge in pure argon. The arc discharge dissociates the evolved carbon monoxide and excites the emission spectrum of oxygen. The intensity ratios of the line pairs O 7772 A/Ar 7891 A and O 7775 A/Ar 7891 A are related to the oxygen concentration. It is shown that the rate and degree of evolution of the oxygen content is sensitively dependent on the environmental conditions in the supporting graphite electrode. Oxygen concentrations in the range from 0.004 to 0.5 weight per cent can be determined with a coefficient of variation of ±5 to 6 per cent of the amount present. (auth)

15622

SPECTRAL DETERMINATION OF Ti AND Ta ADMIXTURES IN PENTAVALENT Nb AND Nb AND Ti IN PENTAVALENT Ta. N. I. Tarasevich and G. V. Kozyreva. Vestnik Moskov. Univ. Ser. Mat., Mekhan., Astron., Fiz. i Khim. 3, 185-8(1959). (In Russian)

A spectral method was developed for determining 0.008 to 0.3% Ta and 0.006 to 0.1% Ti in pentavalent Nb and

0.005 to 0.5% Nb and 0.005 to 0.1% Ti in pentavalent Ta. The mean square error is 8 to 20% depending on the concentration of the admixture. (R.V.J.)

15623

A NEW METHOD FOR THE CONTINUOUS ANALYSIS OF DISSOLVED OXYGEN IN WATER. J. M. Wright and W. T. Lindsay, Jr. (Westinghouse Electric Corp., Pittsburgh). p.706-21 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

An apparatus is described which uses a packed bed of thallium metal for the continuous analysis of dissolved oxygen in water. Thallium is not attacked by water or dissolved gases other than oxygen. With oxygen it forms thallous oxide which is highly soluble in water, thus increasing the specific conductance of the water. The performance of test and prototype units is described with the results compared to Winkler analyses. More precise measurements are required to confirm the accuracy of the device at concentrations below 0.05 ppm. The method appears promising for measurement in the parts-per-billion range and, perhaps, even lower with suitable modifications. (B.O.G.)

General Inorganic and Physical Chemistry

15624 ANL-6156

Argonne National Lab., Lemont, Ill.

THE MOLECULAR AND VISCOUS EFFUSION OF SATURATED VAPORS (thesis). K. Douglas Carlson. Apr. 1960. 261p. Contract W-31-109-eng-38. OTS.

Submitted to Univ. of Kansas.

An investigation of the effusive behavior of saturated vapors over a range of source pressures from 10^{-6} atm in the molecular flow region to 1 atm is reported. The purposes of the investigation were to clarify the situation regarding the upper pressure limit to effusive flow, to examine the transition of effusive flow from molecular to viscous behavior, and to clarify some limited aspects concerning the question of vapor saturation within an effusion cell. Mass flow rates of mercury vapor effusing through a thin-edged orifice or long channels into a vacuum from a region of nearly saturated vapor were obtained. (W.D.M.)

15625 MSAR-60-67

MSA Research Corp., Callery, Penna.

THE REACTION RATE OF SODIUM SULFITE WITH DISSOLVED OXYGEN. Technical Report No. 73. S. J. Rodgers. May 16, 1960. 24p. Contract NObs-77023.

The reaction rate of sodium sulfite was studied as a function of oxygen concentration, Na_2SO_3/O_2 ratio, temperature, catalyst, pH and surface/volume ratio. The reaction rate of hydrazine with dissolved oxygen was also studied. Oxygen removal is incomplete when the sulfite to oxygen ratio is less than the stoichiometric quantity. With the stoichiometric quantities of oxygen and sodium sulfite present, removal is incomplete at 100°F in 1 min, at 200°F, about 95% of the oxygen is removed in 10 sec and at 300°F oxygen removal is essentially complete in 10 sec. With an excess of sulfite present (10 Na_2SO_3/1 O_2, molar), 95% of the oxygen is removed at 100°F in 10 sec. At 200 and 300°F, oxygen removal is essentially complete in 10 sec. The rate of oxygen removal is dependent to some extent on the container material. The sulfite oxygen reaction progresses at a higher rate in boiler water than in feedwater. The reaction rate of hydrazine with oxygen is low compared with the reaction rate of sulfite and dissolved oxygen. No reduction of oxygen was noted over a one-minute period with an excess of hydrazine. (auth)

15626 NYO-8027

Tufts Univ., Medford, Mass.

THE LATENT HEAT OF FUSION OF LITHIUM HYDRIDE FROM CRYOGENIC MEASUREMENTS. Charles E. Messer. May 5, 1960. 6p. Contract AT(30-1)-1410. OTS.

The latent heat of fusion of lithium hydride was evaluated cryogenically from the lowering of the freezing point by the solutes lithium oxide and calcium hydride. Within the additional limits of error created by uncertainty as to solid solution formation, the estimated value of the latent heat is 4900 ± 700 calories per mole at the melting point of 688°C. (auth)

15627 NYO-8028

Tufts Univ., Medford, Mass.

THE HEAT OF FORMATION OF ALUMINUM HYDRIDE FROM HEAT OF REACTION WITH HYDROCHLORIC ACID. Charles E. Messer. May 5, 1960. 8p. Contract AT(30-1)-1410. OTS.

A value for the heat of formation of aluminum hydride has been determined from measurements of the heats of reaction of aluminum hydride etherate and aluminum metal with aqueous hydrochloric acid. This value, including rather large corrections for ether content and various determined impurities, is: $\Delta H°_{298°K.} = -11.1 \pm 2.3$ kcal/mole. This value is to be considered as only provisional, because of additional errors from uncertain composition of the sample, difficult to evaluate. (auth)

15628 ORNL-2933

Oak Ridge National Lab., Tenn.

MOLECULAR ASSOCIATION IN ALKALI HALIDE VAPORS (thesis). S. Datz. May 31, 1960. 77p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tenn.

Molecular association equilibria in alkali halide vapors were studied by measuring the temperature dependence of the molecular weights of gaseous sodium chloride, sodium bromide, sodium iodide, potassium chloride, potassium iodide, rubidium chloride, and cesium chloride. The molecular weights were determined by measurement of the absolute pressure exerted by a known weight of completely vaporized salt contained in an isothermal fused silica bulb of known volume. The pressure sensing element consisted of a fused silica U-tube manometer containing molten gold, and pressures were determined by measuring the argon pressure necessary to balance the gold manometer. The apparatus was used in the temperature range of 1175 to 1430°K and pressures of from 10 to 40 mm were measured with a precision of ±0.05 mm. The temperature dependence of the equilibrium constants for the reaction $(MX)_2 \rightleftharpoons 2MX$ yielded dissociation energies (evaluated at 1300°K) ranging from 48.0 kcal $mole^{-1}$ for sodium chloride to 34.7 kcal for cesium chloride. The entropies of dissociation were found to fall within a small range, varying from 28.3 eu for sodium chloride to 25.0 eu for potassium iodide. A statistical calculation of the entropy changes based on an ionic model was found to agree well with the experimental values. It is shown that these systems may be adequately described with an electrostatic model, although closer attention should be paid to the nature of polarization interactions. (auth)

15629 TID-5914

Iowa. State Univ., Iowa City.

PHASE EQUILIBRIA, KINETIC AND THERMODYNAMIC STUDIES OF SOME RARE EARTH AND OTHER METAL

OXIDE AND NITRIDE SYSTEMS. Technical Progress Report on Project No. 5. LeRoy Eyring, H. S. Schuldt, and Karl S. Vorres. May 15, 1959. 137p. Contract AT(11-1)-72. OTS.

Continuation of studies on the phase relationships and the physical, thermodynamic, and high-temperature properties of oxide and nitride systems of the transition metals is reported. Equilibrium pressure measurements and x-ray diffraction, differential thermal analysis, and thermogravimetric analysis are among the methods being used. Work in progress during the report period was centered around a study of oxidation kinetics of lanthanum, cerium, praseodymium, neodymium, samarium, gadolinium, and ytterbium. Results are tabulated on aspects such as the temperature region in which an activation energy was observed, the rate laws which were obeyed, activation energies, effects of reducing oxygen partial pressures, and effects on inert atmospheres. Preparations for studies of phases produced in the region between rare earth metals and their nitrides are reported. Data are also included on the infrared spectra of rare earth hydroxides, and oxides which provide information on the type and intensity of the hydroxide bonding. A study of kinetics in high vacuum reduction or decomposition of mixed rare earth oxides is also being made. Preliminary investigations are being conducted to select the mixing agent from among ytterbium, erbium, and lutetium oxides. Papers for publication on the oxidation kinetics of cerium and lanthanum are included. (J.R.D.)

15630 TID-5968

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

TRANSIENT ELECTRODE POTENTIALS OF MERCURY. Technical Report No. XXXVII. Carl D. Spear, Milton E. Wadsworth, and Melvin A. Cook. May 15, 1960. 104p. Project No. 1. Contract AT(11-1)-82. OTS.

The transient potentials of mercury were studied as a function of electrolyte, concentration, partial pressure of oxygen, pH, and the common ion effect. The decay potentials were recorded for each experiment. The potential transients were produced by expanding a mercury-free surface in contact with an electrolyte at a constant rate analogous to stretching a wire at a constant rate. (auth)

15631

THE STRUCTURE OF ICE-I, AS DETERMINED BY X-RAY AND NEUTRON DIFFRACTION ANALYSIS: A CORRECTION. P. G. Owston (Imperial Chemical Industries Ltd., Welwyn, Herts, Eng.). Advances in Phys. 9, 147 (1960) Jan.

Corrections are given for a number of errors in a recent paper resulting from the use of an incorrect factor in converting kx to Angstrom units and from the assumption that Truby's (1955) values were given in Angstroms. These corrected values agree with those of Granicher (1958) and Lonsdale (1958). The errors do not affect the discussion, which depended on the ratio c/a rather than on the actual values of a and c. (B.O.G.)

15632

REDUCING PROPERTIES OF CEROUS ION IN ALKALINE MEDIA. N. H. Furman and A. J. Fenton, Jr. (Princeton Univ., N. J.). Anal. Chem. 32, 745-7(1960) June.

The stoichiometric reactions of ferricyanide and permanganate with cerous ion in strong carbonate solutions are described. Ferricyanide can be titrated accurately in an inert atmosphere. An indirect method for determining glucose was developed in which the excess ferricyanide in a carbonate reaction mixture was determined with standard cerous sulfate. This method should be applicable to the indirect determination of many substances that react slowly with ferricyanide. (auth)

15633

ABSORPTION SPECTRA OF MOLTEN FLUORIDE SALTS. SOLUTIONS OF SEVERAL METAL IONS IN MOLTEN LITHIUM FLUORIDE–SODIUM FLUORIDE–POTASSIUM FLUORIDE. J. P. Young and J. C. White (Oak Ridge National Lab., Tenn.). Anal. Chem. 32, 799-802(1960) June.

Spectra are presented for nickel fluoride, cobalt fluoride, chromic fluoride, praseodymium fluoride, uranium tetrafluoride, and uranyl fluoride dissolved in molten lithium fluoride–sodium fluoride–potassium fluoride at temperatures ranging from 500° to approximately 650°C. These spectra are compared to similar spectra obtained in other molten salts and aqueous solutions. General procedures are described which were used in preparing the fluoride salt melt and in recording the spectra by means of a high-temperature cell assembly designed for use with a Cary recording spectrophotometer, Model 14M. (auth)

15634

THE REDUCTION OF EUROPIUM SESQUIOXIDE AND THE PREPARATION OF EUROPIUM PROTOXIDE. Jean-Claude Achard. Compt. rend. 250, 3025-6(1960) May 2. (In French)

The reduction of europium sesquioxide leads to the formation of several intermediate compounds. One of these is europium protoxide for which a method of preparation is given. (tr-auth)

15635

OXIDATION-REDUCTION EQUILIBRIUM IN THE SYSTEM URANIUM–IRON IN A CARBONATE ENVIRONMENT AND ITS SIGNIFICANCE IN GEOCHEMISTRY. G. B. Naumov and O. F. Mironova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow). Geokhimiya No. 3, 241-6(1960). (In Russian)

Experimental investigations show that the oxidation-reduction equilibrium in the iron–uranium system in a carbonate, neutral, and weakly alkaline environment is practically completely shifted in the direction of uranium oxidation and iron reduction. Such equilibria may occur under natural conditions, in particular in hydrothermal uranium-bearing solutions. (auth)

15636

POLAROGRAPHY OF NIOBIUM AND TANTALUM. R. Gut (Eidgenössische Technische Hochschule, Zurich). Helv. Chim. Acta 43, 830-42(1960). (In German)

The polarographic behavior of Nb^V and Ta^V in aqueous solvent systems does not allow a simultaneous determination of the two metals in presence of each other. Therefore, some organic solvents were investigated. Characteristic waves were obtained for Nb^V in acetonitrile and for Nb^{IV} in dimethylformamide. Melts of the system NaCl–KCl–$AlCl_3$ proved to be much more favorable, however. $NbCl_5$ and $TaCl_5$ as solutes are present in such melts as monomolecular species and their products of hydrolysis, if any, are converted into the pentachlorides by $AlCl_3$, one of the components of the solvent. In this kind of melt Nb^V yields a polarographic double wave ($Nb^V \rightarrow Nb^{IV} \rightarrow Nb^{III}$) and Ta^V a single wave ($Ta^V \rightarrow Ta^{III}$). The half wave potentials of the reductions of the two metals differ by 500 millivolts. (auth)

15637

OXIDATION OF NIOBIUM IN THE TEMPERATURE RANGE 350°-750°C. D. W. Aylmore, S. J. Gregg, and W. B. Jepson

(Univ. of Exeter, Eng.). J. Electrochem. Soc. 107, 495-501 (1960) June.

The kinetics of the oxidation of niobium in dry oxygen at 1 atm pressure were measured at temperatures in the range 350 to 750°C with some additional measurements at 0.1 atm. At 350°C, in tests lasting 270 hr, the oxidation is protective, but at 400°C and above the metal oxidizes, after an initial period, at a constant rate with a second breakaway reaction (rate transition) at 450 and 500°C but not at higher temperatures. The anomalous temperature coefficient of the linear rate was confirmed. The specific surface of the oxide scale was measured and, apart from an anomaly at 400°C, is shown to decrease with increasing temperature of oxidation and this is ascribed to sintering. The oxidation kinetics of a purer batch of niobium were also investigated. The effect of moisture is to decrease the rate at 400 and 450°C, whereas at 600°C the rate is unchanged. (auth)

15638

THE DIFFERENCE EFFECT AND ANODIC BEHAVIOR OF ZIRCONIUM DISSOLVING IN HYDROFLUORIC ACID. M. E. Straumanis, W. J. James, and W. C. Custead (Univ. of Missouri, Rolla). J. Electrochem. Soc. 107, 502-6(1960) June.

Zirconium dissolving in hydrofluoric acid exhibited a positive difference effect of such an efficiency that the hydrogen volume developed by the internal polarization current was completely overbalanced by the effect. As with other metals the effect was independent of the concentration of the acid and was accompanied by a strong shift in potential of the Zr electrode toward noble values (passivation). Similar potential changes were also recorded in presence of salts or more noble metals while they were displaced by the Zr. Simultaneously, the rate of dissolution of Zr dropped (nearly to zero with Pt^{4+} additions). In the latter case the black hydride film on the surface disappeared and the Zr turned bright and shiny (passive Zr). A decrease in formation of the hydride film was observed in other cases of anodic polarization. The activity of Zr returned when the anodic current was cut off. As the effect of local currents due to anodic polarization is reduced to a minimum, the high rate of dissolution of Zr is explained by direct chemical action of Zr with molecular HF. (auth)

15639

DIVALENT THULIUM. THULIUM DI-IODIDE. L. B. Asprey and F. H. Kruse (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem. 13, 32-5(1960) Apr. (In English)

The preparation and identification of a divalent thulium compound, TmI_2, is reported. Lattice constants for the hexagonal structures of TmI_2 and YbI_2 are: TmI_2, a_0 = 4.520 ± 0.003 A, c_0 = 6.967 ± 0.006 A; and of YbI_2, a_0 = 4.503 ± 0.003 A, c_0 = 6.972 ± 0.004 A. (auth)

15640

NITRO COMPLEXES OF NITROSYLRUTHENIUM. P. G. M. Brown (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 73-83(1960) Apr. (In English)

Complexes of nitrosylruthenium or mixtures of these, with the general formula $[RuNO(NO_2)_x(NO_3)_y(OH)_{3-x-y}(H_2O)_2]$ with $x \geq 1$, were isolated as solids. Of these one, $[RuNO(NO_2)_2OH(H_2O)_2]$, was prepared by the action of dilute acid on $Na_2[RuNO(NO_2)_4OH]$ and two others with empirical formulae $[RuNO \cdot NO_3(NO_2)_2(H_2O)_2]$ and $[RuNO(NO_2)_3(H_2O)_2]$, were obtained by evaporation in vacuo of solutions formed in nitric acid by the action of oxides of nitrogen ($NO + NO_2$) on (RuNO) nitrato complexes. The complexes were identified by quantitative analysis for the various groups present by infra-red spectroscopy and paper chromatography. As might be expected of complexes containing the nitro ligand, the formation and interconversion reactions are slower than those of the corresponding (RuNO) nitrato complexes. (auth)

15641

INFRARED AND RAMAN SPECTRA OF $N_2{}^{14}O_4$ AND $N_2{}^{15}O_4$. G. M. Begun (Oak Ridge National Lab., Tenn.) and W. H. Fletcher (Univ. of Tennessee, Knoxville). J. Mol. Spectroscopy 4, 388-97(1960) May.

The infrared spectra of gaseous and liquid $N_2{}^{15}O_4$ were observed from 340 to 5500 cm^{-1} and the Raman spectra of liquid and solid $N_2{}^{15}O_4$ were recorded. The corresponding spectra of $N_2{}^{14}O_4$ were observed to provide an accurate measure of the isotope shifts. Assignments of all eleven active fundamental frequencies have been made. These assignments fit the product rule within experimental error and account for all observed overtones. (auth)

15642

FLUORESCENCE OF VARIOUS MODIFICATIONS OF URANYL SULPHATE. D. N. Pande (D.S.B. Government College, Naini Tal, India). J. Sci. Ind. Research (India) 19B, 71-2(1960) Feb. (In English)

A study was carried out on the effect of polymorphic changes in uranyl sulfate under various conditions of recrystallization on its fluorescence spectrum. Analytical grade $UO_2SO_4 \cdot 3H_2O$ (I) and I prepared from UO_3 and $UO_2(NO_3)_2 \cdot 6H_2O$ were found to give identical spectra if prepared under the same crystallization conditions. A different modification of I (II) was obtained for crystallization temperature below 20°C and contains 4 water molecules; it has a different spectrum from that of I. II is easily converted into I by heating to 40°C, but if II is kept in a closed vessel for some days, III is formed which does not change into I until heated to 150°C. Several other modifications of uranyl sulfate were prepared by dessication of I; the spectrum of the dehydrated salt (V) displays increased intensity at low temperatures in contrast to the others and is different from that of the salt dehydrated by H_2SO_4. Upon adsorption of moisture, V gives spectrum bands corresponding to I and II, II first being formed and then converted into I. It is concluded that the difference between the spectra of I and II is not due to two different hydrates. (D.L.C.)

15643

SOME RELATIONS BETWEEN THE MECHANISM OF THE REACTION $CO_{(gas)} \xrightarrow{I_2O_5} CO_{2(gas)}$ AND THE KINETIC ISOTOPE EFFECT FOR C^{14}. Ignacy Złotowski and Mieczysław Zieliński (Uniwersytet, Warsaw). Nukleonika 4, 599-610(1959). (In Polish)

The kinetic isotope effects of C^{14} in the oxidation process, $CO_{(gas)} \xrightarrow{I_2O_5} CO_{2(gas)}$, at 50°C (2.14 ± 0.4%) and 100°C (1.81 ± 0.4%) were determined. The experimental results were compared with the kinetic isotope effects data calculated theoretically for the three consecutive stages of the process: the adsorption of CO, the reaction of oxidation, and the desorption of CO_2. It appears that the adsorption of CO is the slowest and therefore the rate-determining step. Evidence is presented that suggests that in the intermediate active complex O...C...O...I the bonds between the C-atom and the two atoms of oxygen are equivalent, the oxidizing atom of oxygen being already very strongly attached to the CO molecule. On the other hand, in the active complex the bonds of the active oxygen atom do not appear to be equivalent to the I-atom of I_2O_5 and the C-atom of CO. (auth)

15644

HEAT CAPACITY OF SODIUM AND POTASSIUM AT TEMPERATURES BELOW 1°K. William H. Lien and Norman E. Phillips (Univ. of California, Berkeley). Phys. Rev. 118, 958(1960) May 15.

The heat capacities of sodium and potassium were measured from about 0.15°K to just above 1°K. No anomaly was observed in either case: the heat capacity could be represented by the sum of a term linear in temperature and a cubic term. Values of the Debye temperatures and effective masses of the conduction electrons are given. (auth)

15645

CONTAMINANT ABSORPTION BANDS IN THE INFRARED SPECTRA OF INORGANIC FLUORIDES. W. R. Heslop, J. A. A. Ketelaar, and A. Büchler (Arthur D. Little, Inc., Cambridge, Mass.; Univ. of Amsterdam; and Harvard Univ., Cambridge, Mass.). Spectrochim. Acta 16, 513-17 (1960) May.

The frequent occurrence of infrared bands at 13.75μ (due to Na_2SiF_6) and at 9.7 and 8.2μ (due to SiF_4) in inorganic fluorides and other halides is noted. SiF_4 may form by reaction between glass and fluoride; Na_2SiF_6 subsequently forms by reaction of SiF_4 with a NaCl cell window. It is concluded that commercially available $BeCl_2$ and ZnF_2 contain SiF_2 as impurity. (D.L.C.)

15646

FUSED SALT CHEMISTRY. George J. Janz (Rensselaer Polytechnic Inst., Troy, N. Y.). p.169-81 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Structural aspects of molten salts which are of current interest among both theoretical and experimental research workers are discussed. Models for molten salts based on liquid state theories and on electrochemical properties of these systems are considered. Experimental methods and current problems in the fields of pure molten salts and mixtures are also surveyed. (J.R.D.)

15647

METHOD FOR THE PREPARATION OF PLUTONIUM HALIDES AND OXYHALIDES. N. R. Davidson and J. J. Katz (to U. S. Atomic Energy Commission). U. S. Patent 2,926,068. Feb. 23, 1960.

Plutonium trihalide or plutonium(III) oxyhalide is prepared by reacting plutonium dioxide with hydrogen halide at 300 to 1000°C in the presence of hydrogen, ammonium iodide, or ammonium bromide.

Radiation Chemistry and Radiochemistry

15648 AERE-C/R-1575(1 to 6) Suppl. 3

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SELECTED ABSTRACTS OF ATOMIC ENERGY PROJECT UNCLASSIFIED REPORT LITERATURE IN THE FIELD OF RADIATION CHEMISTRY AND BIBLIOGRAPHY OF THE PUBLISHED LITERATURE 3rd ANNUAL SUPPLEMENT (PAPERS NOTED UP TO DECEMBER 1958). R. W. Clarke, comp. July 1959. 406p. BIS.

A compilation of abstracts on radiation chemistry in the areas of aqueous organic systems, water, organic compounds, gaseous systems, solid systems, biochemistry and radiobiology, industrial uses, corrosion, equipment, and theory is presented. Abstracts of project reports are given along with open literature references. (J.R.D.)

15649 HW-17769

Hanford Works, Richland, Wash.

TERMINAL REPORT ON THE RADIOLANTHANUM LABORATORY. I. LABORATORY AND LABORATORY EQUIPMENT DESIGN. J. K. Figenshau. July 21, 1950. Decl. May 5, 1960. 133p. Contract [W-31-109-Eng-52]. OTS.

A description of laboratory process equipment, step-by-step laboratory operations, and safety hazards of the RaLa Process is given. Diagrams of various components of the laboratory equipment are contained. (C.J.G.)

15650 NYO-7231

Brooklyn. Polytechnic Inst.

STUDY OF RADIATION INDUCED SOLID STATE POLYMERIZATION. Annual Progress Report for February 1, 1958 to February 1, 1959. 35p. Contract AT(30-1)-1715. OTS.

Acrylamide and acrylic acid salts were irradiated in the crystalline state with Co^{60} γ rays at − 70°C. The changes of polymer yield and molecular weight were followed as a function of time. Polymerization of acrylamide in solid solutions containing 5 or 10 mole % of the isomorphous propionamide gives evidence that the propionamide acts as a fairly efficient chain transfer agent. The polymerization of acrylic acid salts varies greatly with the cation, the potassium and calcium salts polymerizing rapidly at ordinary temperatures, while the sodium and lithium salts react appreciably only above 120°C. Methacrylic acid salts could not be polymerized under the conditions investigated. Butadiene-1-carboxylic acid polymerizes spontaneously in the crystalline form to cross-linked products. (W.D.M.)

15651 JPRS-2666

THE SEPARATION OF THE NUCLEAR ISOMERS OF TELLURIUM, MERCURY AND TIN. A. N. Murin, V. D. Nefedov, E. (Ye.) N. Sinotova, and O. V. Larionov. Translated from Zhur. Neorg. Khim. 3, 181-3(1958). 7p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 13841.

15652

X-RAY INDUCED REDUCTION OF POTASSIUM PERMANGANATE AND MANGANATE IN ALKALINE SOLUTION. B. Jeżowska-Trzebiatowska and J. Kaleciński (University, Wrocław and Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci., Ser. sci. chim. 8, 27-31(1960). (In English)

Investigations on the reduction of potassium permanganate by ionizing radiation show that it is reduced to Mn(II) in strongly acidic media, while in a neutral or weakly acidic one—to Mn(IV). The MnO_4^- reduction yield depends on the pH of the solution and markedly lowers with decreasing acidity. The study was extended to include alkaline solutions and to determine the reduction mechanism for $KMnO_4$ and MnO_4^-. At low pH values, (acidic and weakly alkaline) an inverse phenomenon is observed, i.e., an increase in yield, G, with lowering pH (in neutral solutions G = 6.1 and weakly alkaline G = 4.6). The smaller reduction yield for weakly alkaline solutions, as compared with neutral and strongly alkaline, may be caused by increasing participation of accumulated manganate. (B.O.G.)

15653

RADIATION CHEMISTRY OF CYCLOHEXANE. II. DOSE

RATE EFFECTS ON THE FORMATION AND DESTRUCTION OF CYCLOHEXENE. P. J. Dyne and J. W. Fletcher (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem. 38, 851-7(1960) June.

Prolonged radiolysis of cyclohexane leads to a steady-state concentration of cyclohexene where G(cyclohexene) = 0. At concentrations greater than this steady concentration, cyclohexene is destroyed. It is shown that this steady-state concentration is a function of dose rate, varying approximately as the fourth root of the radiation intensity. A discussion of these and other observations indicates that dose rate and linear energy transfer effects are observed in cyclohexane only if radical scavengers are present and that cyclohexene, a product of radiolysis, acts as a radical scavenger in irradiated cyclohexane. (auth)

15654

THE DECOMPOSITION OF METHANE BY LOW-ENERGY ELECTRONS. J. E. Manton and A. W. Tickner (National Research Council, Ottawa). Can. J. Chem. 38, 858-68 (1960) June.

The decomposition of methane by a beam of electrons having energies between 15 and 100 ev was studied using methane pressures between 10^{-2} and 10^{-3} mm of mercury. The products were frozen out on a surface cooled to about −220°C and situated approximately 5 millimeters from the electron beam. Ethane, ethylene, and acetylene were found to be the main products along with smaller amounts of saturated and unsaturated higher hydrocarbons. The results provide some evidence that under these experimental conditions ions do not play a major part in the decomposition and a free radical mechanism is proposed to explain the formation of the main products. (auth)

15655

THE PREPARATION OF A NEW ISOTOPE OF GALLIUM. Christian Ythier. Compt. rend. 250, 3012-13(1960) May 2. (In French)

A description is given of the method for the chemical isolation of radiogallium produced by transmutation. The method permits the rapid separation of the new gallium isotope which is probably Ga^{75} with a half life of 1.5 ± 0.5 min. (tr-auth)

15656

RADIOLYSIS OF POTASSIUM BROMIDE SOLUTIONS UNDER THE ACTION OF 660 Mev PROTONS. S. A. Brusentseva and P. I. Dolin. Doklady Akad. Nauk S.S.S.R. 131, 117-19(1960) Mar. 1. (In Russian)

Radiolysis of aqueous solutions of $FeSO_4$ and KBr with Co^{60} γ radiation and 660-Mev protons was compared. The results show that the radiochemical phenomena are determined by the energy loss values per unit dE/dx. It is postulated that 660-Mev protons and Co^{60} γ rays induce identical effects. (R.V.J.)

15657

INVESTIGATIONS OF THE PROCESSES OF ENERGY TRANSFER IN RADIOLYSIS OF CERTAIN FROZEN HYDROCARBONS BY MEANS OF THE E. S. R. METHOD. Yu. N. Molin, I. I. Chkheidze, A. A. Petrov, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Kinetics and Combustion, Siberian Branch of the Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 125-8(1960) Mar. 1. (In Russian)

Energy transfer in the radiolysis of frozen compounds was studied with dicyclohexyldodecane, diphenyldodecane, 1-phenyl-1-cyclohexyldodecane, the 1:1 mixture of the first and second compounds, and with cyclohexane and benzene. Measurements were taken of the electron paramagnetic resonance spectra following irradiation by 1.6-Mev fast neutrons at −120°C, and the kinetics of radical accumulation were investigated. (R.V.J.)

15658

NEW DATA CONCERNING THE INFLUENCE OF THE SOLID PHASE RADIOACTIVITY ON THE HETEROGENEOUS PROCESS INVOLVED IN ISOTOPIC EXCHANGE. I. E. Mikhailenko and Vikt. I. Spitsyn (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 129-32(1960) Mar. 1. (In Russian)

The rate of sulfur exchange was studied in high specific activity (up to ~130 mc/g) preparations of K_2SO_4 at various temperatures, and the mechanism of the exchange was investigated. It was found that sulfur exchange takes place at 700°C and above. Isotopic exchange between $K_2SO_4-SO_3$ and $K_2SO_4-SO_2$ is practically identical at 840°C. (R.V.J.)

15659

PRIMARY PROCESSES IN THE ACTION OF IONIZING RADIATIONS ON WATER: FORMATION AND REACTIVITY OF SELF-TRAPPED ELECTRONS ('POLARONS'). Joseph Weiss (King's Coll., Newcastle upon Tyne, Eng.). Nature 186, 751-2(1960) June 4.

Recent evidence is reviewed which indicates that positive as well as negative ionic species formed from the water may be important in the radiation chemistry of aqueous systems. Evidence is presented that there are two reducing species present in solution, namely hydrogen atoms and electrons. The self-trapped electrons in the dielectric medium (water) were tentatively identified with the polaron. Results of recent studies are reported which indicate that these polarons are normally relatively stable. The known physical characteristics of polarons are summarized, and reactions in water are discussed. The interaction of two polarons in irradiated water is considered. Results of electron spin resonance measurements on irradiated ice and frozen acids are reported as giving further indication for the existence of polarons. (C.H.)

15660

PAPER CHROMATOGRAPHIC DETECTION OF HISTAMINE IN X-IRRADIATED HISTIDINE SOLUTIONS. Kurt Flemming (Universität, Greifswald, Ger.). Naturwissenschaften 47, 205-6(1960). (In German)

Aqueous histidine solutions irradiated with ultraviolet or x radiation react to pharmacological test objects as histamine. However, the histamine has not yet been identified chemically in the solution exposed to ionizing radiation. A method was formulated for the detection. The "histamine fraction," obtained by the Koessler-Hanke method, was evaporated in vacuum and the dry residue was dissolved in water. The histamine can then be detected by paper chromatography because the active material is 100 times more concentrated than in the initial solution. (J.S.R.)

15661

IRRADIATION OF CHEMICAL REAGENTS IN NUCLEAR REACTORS. Samuel Baxter (to Monsanto Chemicals, Ltd.). British Patent 835,121. May 18, 1960.

A method of irradiating chemicals in reactors is described which involves introduction of the chemicals into the inert coolant. In an example, gaseous ethylene is put in the coolant of a gas-cooled graphite-moderated reactor, and polyethylene removed from the gas stream at suitable points. (T.R.H.)

Raw Materials and Feed Materials

15662 CCCO-857
Catalytic Construction Co., Philadelphia.
PROCESS ENGINEERING REPORT. OPERATING MANUAL FOR SUPERVISORY PERSONNEL [FOR] GREEN SALT PLANT OF THE FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO. PART IX, SECTION NO. 5-3. (JOB NO. 3004). E. D. Innes, George V. Holby, and W. Snyder. Dec. 11, 1952. Decl. Apr. 21, 1960. 113p. Contract AT(30-1)-1060. OTS.

A manual for supervisory personnel to aid in formulating detailed instructions for operators and foremen employed in a green salt plant is given. A description of the process-steps in plant operation is contained. (C.J.G.)

15663 KLD-46
Carbide and Carbon Chemicals Co. [K-25 Plant], Oak Ridge, Tenn.
CORRELATION OF THERMOBALANCE DATA. J. H. Pashley. Jan. 20, 1955. Decl. Apr. 28, 1960. 23p. Contract [W-7405-eng-26]. OTS.

A study of the hydrofluorination reaction rate constants obtained from thermobalance studies of the reaction of HF with UO_2 is reported. Initial rate constants are correlated with temperature and HF pressure in excess of equilibrium pressure. It is indicated that the rate constants are not independent of the fraction conversion. (C.J.G.)

15664 KY-197
Union Carbide Nuclear Co. Paducah Plant, Ky.
RECOVERY OF URANIUM HEXAFLUORIDE FROM VENT GASES. T. J. Mayo, W. R. Golliher, and W. R. Rossmassler. Dec. 14, 1956. Decl. Mar. 30, 1960. 8p. Contract W-7405-eng-26. OTS.

Three materials, UO_3, U_3O_8 and UF_4, were tested for their ability to absorb or react with low concentrations of UF_6 in the presence of large amounts of fluorine and air. It was found that at 400°F a fluidized bed of UF_4 will react with the UF_6 and that UF_6 in the amount of 10% of the weight of the UF_4 can be reacted before detectable UF_6 is found in the gas leaving the reactor. (auth)

15665 MCW-1378
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. W. M. Leaders and J. H. Yeager. Aug. 1, 1955. Decl. Mar. 31, 1960. 162p. Contract W-14-108-Eng-8. OTS.

Pilot plant studies on the purification of uranyl nitrate by extraction with tributyl phosphate are discussed. The design and performance of the continuous denitration equipment is described. The production and testing of dingots are outlined. Methods were developed for improving the metal quality of the ingots. The hydrogen content of various types of U metal was determined and procedures were investigated for reducing the hydrogen content in U metal. Corrosion studies were carried out on several equipment items under actual operating conditions. The startup and initial operation of the derby pickling facility and the operation of the green salt reactors are described. (C.W.H.)

15666 MCW-1385
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. Apr. 1, 1956. Decl. Mar. 31, 1960. 115p. Contract W-14-108-eng-8. OTS.

The rates of solution and solubilities of MgF_2 in synthetic feed solutions are dependent on the physical treatment which the MgF_2 has undergone; uranium and Al increase the rate of solution. An amenability test based on rate of solution of MgF_2, was devised for fluoride-containing feeds to minimize corrosion problems. A cross-current extraction amenability test was developed for assigning a chemical extractability index to feed solutions. Relative mass-transfer measurements for Eu and U indicate that Eu should be readily scrubbed from TRP solutions of U. A partial deactivation of the UO_2 was noted in the plant hydrofluorination step. The rate of reduction of UO_3 by H_2 varied considerably with the method of UO_3 preparation. Electron-microscope examinations were made of several UO_3 samples. Analytical procedures were developed for determination of total NO_3^- in U feed solutions, unoxidized U in U_3O_8, fluoride in UF_4 and MgF_2, and O_2 and H_2 in uranium. The performance of an automatic titrator for U analysis is described. Hydrogen held tightly by slag liner (as $Mg(OH)_2$) is the major source of H_2 present in the production of U. (C.W.H.)

15667 MCW-1388
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. May 1, 1956. Decl. Mar. 31, 1960. 92p. Contract W-14-108-eng-8. OTS.

Operation of the TBP–hexane extraction cycle in the pilot plant was continued to develop design and operating data for the Weldon Spring operation. Power requirements and heat transfer capacity of the continuous raffinate denitrator were obtained. Uranium chip reprocessing, slag grinding, and development of techniques for U casting are reported. Determination of H in U metal, investigation of the dingot process and dingot forging were studied. Hazards associated with the HNO_3 digestion of U-can metal, quality comparison of UF_4 produced at 340 lb/hr and 380 lb/hr, and the advantages of the vertically split molds were studied. (For preceding period see MCW-1385.) (W.L.H.)

15668 MCW-1392
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. Nona McCalpin, ed. July 1, 1956. Decl. Mar. 31, 1960. 120p. Contract W-14-108-eng-8. OTS.

The effects of sulfate, fluoride, and phosphate impurities, and the counter effects of Fe and Al on the distribution of U between diethyl ether and aqueous nitrate solutions are discussed. The relative rates of transfer of Cu and Ce to the rate of transfer of U, the nature and control of organic contamination of refinery liquors, reactivity tests for UO_3, hydrofluorination of UO_2, and the caking in mixtures of UO_2–UF_2 were described. Investigation of the sources of H in as-reduced U was continued. A preliminary study was made of a rapid gravimetric determination of Fe in a ferric nitrate solution containing U and excess of HNO_3. A neutron activation method was adapted for the determination of the U^{235} content of feed materials using a small neutron source. (W.L.H.)

15669 MCW-1407
Mallinckrodt Chemical Works, St. Louis.
PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. LABORATORY WORK. Barbara Elliott, ed. Oct. 1, 1957. Decl. Mar. 31, 1960. 118p. Contract W-14-108-eng-8. OTS.

The presence of aluminum in the ratio 3 moles to 1 mole of fluoride holds 90% of the fluoride in the raffinate during boildown. Ferric iron decreases the volatility of fluoride slightly, but is ineffective in significantly lowering the volatility of chloride. Ingot metal dissolves about 2½ times as fast as dingot uranium. Dingot metal containing 400 ppm added carbon dissolves at rates compar-

able to ingot metal. The dissolution rate of normal dingot is grossly affected by addition of small quantities of sulfuric or phosphoric acid to the nitric. A 3 vol. % addition of concentrated H_2SO_4 results in a 30-fold increase of the dissolution rate in 70 wt. % nitric acid while 2 vol. % H_3PO_4 gave a 10-fold increase. Laboratory thermobalance tests gave the following results. Although the reduction rate to UO_2 of MCW sulfated UO_3 was only slightly greater than plant unsulfated orange, the hydrofluorination rate of the brown derived from the sulfated material was 3—4 fold faster. Fluid-bed reduced UO_2 hydrofluorinated two to three times faster than normally reduced brown. Micropulverized UO_3 reduced 1.2 times as fast as unground oxide, but the resulting UO_2 showed a greater enhancement of hydrofluorination reactivity than that obtained by sulfation. Data on static bed dehydration of $UF_2 \cdot {}^3/_4\ H_2O$ in air, nitrogen, hydrogen, and a mixture of nitrogen and hydrogen atmospheres are reported. Uranium tetrafluoride containing less than 0.1% water, 1.0% AOI and 1.0% uranium(VI) can be produced by programmed drying in a nitrogen atmosphere. Techniques developed for gas evolution work were applied to hydrogen balance studies. It appears that 50 to 75% of the hydrogen available in the bomb components is discharged, either as H_2 or as combined hydrogen in the gases evolved from the bomb. Conversion of combined hydrogen in the bomb components to H_2 in the gas phase occurs to a variable extent depending on the type of liner employed. The quantity of hydrogen found in the uranium after firing varied from 3 to 50% of the total hydrogen left in the bomb components (metal, slag, linear). This suggests that the problem of producing low hydrogen metal is partially one of controlling the distribution of the hydrogen among bomb components. The rate of heating of the charge in a 500 g reduction bomb was found to be affected by differences in hydrogen evolution characteristics of the liner. No significant difference could be seen in the heat conductivities of regular and roasted MFL liners. Under development is a gravimetric method for determining relatively non-volatile organic matter in plant stream samples. The method consists of extracting the organics into hexane which can be volatilized, leaving a weighable residue. A method of determining uranium in raffinate slurries is being investigated. The method consists of obtaining x-ray fluorescent measurements on the evaporated slurry to which has been added strontium as an internal standard and is an extrusion of the method developed for precipitated raffinate. A widely applicable gamma-spectrometric method for determining uranium-235 is being developed. A relative precision of about ±1.5% appears possible. (auth)

15670 MCW-1409

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART II. PILOT PLANT WORK. Barbara Elliott and John Nelson, eds. Nov. 1, 1957. Decl. Mar. 31, 1960. 80p. Contract W-14-108-eng-8. OTS.

Experimental studies were made of the continuous oxidation of chloride in 12 percent nitric acid by means of potassium permanganate. With an acid feed content of 200 ppm of chloride, the effluent chloride concentration was reduced to 27 to 33 ppm using 1.5 to 2.0 pounds of permanganate per 100 gallons of acid at 190°F. Air sparging was tried, but showed no advantage over mechanical agitation. A study was made to determine the mechanism of leakage of sodium (organic-insoluble) through the pumper-decanter system of the TBP extraction pilot plant. Experimental results indicate that physical entrainment of aqueous feed liquor in the organic phase can account for the concentrations of sodium found in product liquors and wash raffinate. Similar results were obtained when magnesium was added to the feed. A decontamination factor of about 5×10^2 was observed for the pumper-decanters. A 10-inch diameter electrically heated fluid bed reactor for the denitration of uranyl nitrate solution was set up and two exploratory runs were made. Difficulties were experienced with plugging in the off-gas system and burnout of electrical heaters, but some uranium trioxide was produced in the form of 100-mesh spherical particles with low water and nitrate contents. Dingot bomb reductions indicate that high assay green salt (above 96.5% UF_4) and prolonged heating prior to firing (700 minutes or more) represent a favorable combination of factors to achieve high metal yields and low hydrogen contents. Exploratory gamma extrusions of Adrian have demonstrated that (a) chromium carbide is superior to high speed steel as a die material in resisting erosion; (b) a chromium-cobalt base alloy that is much less brittle may be an interesting alternate if an appropriate lubricant can be developed. Full scale dingot trials of gamma extrusion at Dow Chemical Company disclosed a need for revisions in heating controls and handling equipment but provided two successful extrusions. (auth)

15671 MCW-1419

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. LABORATORY WORK. John Nelson, ed. Oct. 1, 1958. Decl. May 11, 1960. 224p. Contract W-14-108-eng-8. OTS.

Extraction profiles for zirconium under the conditions of the Weldon Spring refinery were determined, and little decontamination difficulty for the refinery was predicted. Amenability tests of Ohio Oil Company and Northgate Lignite Company lignite concentrates showed that if high acid concentrations are used for the digestion, these concentrates can be processed with zirconium decontamination factors of approximately 1000. Fluid-bed-reduced UO_2 prepared from sulfated UO_3 hydrofluorinates faster at temperatures in the vicinity of 400°C than temperatures above and below this for the determination of calcium and sodium in Canadian ore concentrates. (auth)

15672 MCW-1443

Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.

LABORATORY EVALUATION OF CRUSHED CROWN MAGNESIUM FOR URANIUM METAL PRODUCTION. S. W. Weidman and R. F. Leifield. May 31, 1960. 25p. Contract W-14-108-Eng-8. OTS.

"Crushed crown" magnesium (Pidgeon process product) has been evaluated on a small scale for possible use in uranium production. This evaluation is based on results obtained when the material was used to reduce uranium tetrafluoride (green salt) in a laboratory-sized version of the production dingot (direct ingot) thermite bomb scaled to produce four kilograms of uranium metal. The small-scale reactor is known to simulate closely the production-size reactor; it was shown that 4-kg and 3300-lb dingot bombs yield uranium containing similar hydrogen concentrations when the bombs are ignited at identical charge-center temperatures and that metal purity and density are generally comparable for uranium from production and laboratory-scale bombs. However, crude uranium yields from laboratory bombs are generally lower than from production bombs when both are ignited at identical charge temperatures. Crushed crown magnesium differs from "chipped" magnesium (the type used in many A.E.C. ura-

nium production plants) primarily in its higher specific surface area, hydrogen content, and nitrogen content. However, purity and hydrogen content of uranium produced under simulated plant conditions were acceptable when using the best of the five types of crushed crown magnesium tested. No critical problems in either handling or bomb behavior, such as routine premature ignition or increased reaction violence, were noted. Average crude uranium yields were somewhat (3%) below those attained using chipped magnesium. Crushed crown magnesium can probably be obtained for approximately 10% less than the cost of chipped magnesium. Since the poorer yields in the small-scale reactor may reasonably be expected to be overcome in the plant, plant testing under extended preignition heating conditions, particularly of −10 +30 mesh material, is therefore recommended. (auth)

15673 MCW-1446
Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.
PROCESS DEVELOPMENT QUARTERLY PROGRESS REPORT [FOR] JANUARY–MARCH 1960. May 2, 1960. 45p. Contract W-14-108-Eng-8. OTS.

Further data regarding the stability of ignited uranium ore concentrate samples are presented. These data indicate that, with proper care in handling the ignited concentrates, valid assay results can be obtained without the subsequent redrying now used. The tendency for emulsion formation in TBP extractions of uranium concentrate is decreased by increased TBP concentration of the solvent. Some surfactants are also effective at low concentration in decreasing the emulsion tendency. The principal source of vanadium contamination in highly saturated organic extracts is aqueous entrainment. No evidence of significant contamination of the refinery product by extractable vanadium has been seen. The fluid-bed denitrator continued to demonstrate reliability in sustained operation. Further studies of the effect of sulfate level and spray nozzle design on the particle size distribution of the product were carried out. Productivity studies were continued in the pilot-plant fluid-bed reduction reactor using fluid-bed UO_3 as feed and a bed temperature of 1200°F. A study of the use of fluid-bed-dried green salt as a means of controlling the hydrogen content of as-reduced uranium metal indicates that the hydrogen content of 300-lb derbies can be reduced by about 1 ppm provided that the bomb center temperature at ignition reaches at least 550°F. The use of perforated bomb shells appears to lower the hydrogen content an additional 1 ppm. (auth)

15674 NLCO-725
National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1958 TO MARCH 31, 1958. Decl. Apr. 28, 1960. John W. Simmons, ed. 99p. Contract AT(30-1)-1156. OTS.

Complete digestion and extraction evaluations of three feed materials (Can-Met, Lake Nordic, and Lakeside Monarch) are reported. The equilibrium curve for the system tributyl phosphate-water-nitric acid is presented to an equilibrium aqueous nitric acid concentration of 12M. Laboratory tests have shown that the presence of a degraded kerosene diluent in the tributyl phosphate-kerosene solvent system has little or no effect on uranium equilibrium distribution in the extraction of uranium by an organic solvent, but increasing degradation causes an increasingly significant change in uranium distribution when the uranium is re-extracted from the organic solvent. A coalescer-de-entrainer test unit for aqueous and solids removal from primary extract (AP) stream was designed and evaluated in the refinery. Water, solids, and iron decontamination of the AP stream was achieved by the unit. Tests performed in a laboratory denitration pot have shown that: heat input during denitration of $UO_2(NO_3)_2$ influences the residual volatile content of the product UO_3; increasing the sulfate content of UO_3 increases the sulfate content of UO_2 produced from it; and the laboratory denitration procedure is highly reproducible. Ammonium diuranate was precipitated continuously at a relatively low pH. The resulting slurries filter and settle more rapidly than do those from batch precipitations at higher pH. Plant tests were conducted using 20% and 10% HF excesses instead of the usual 150% excess, in the production of UF_4 from UO_3. These tests showed that a low HF excess results in a product of higher quality. A gas analyzer was fabricated that measures the HF in the H_2O–HF stream from a green salt (UF_4) reactor by measuring the conductivity of the condensate. Laboratory studies have shown the feasibility of processing uncalcined IRP tailings (low-uranium-content magnesium fluoride) in the hydrometallurgical system of the metals recovery plant. A small but significant increase in derby metal yield was obtained using Domal coarse-ground granular magnesium. Devices were designed and installed for regulating the flow of UF_4–Mg briquettes and charging them into the continuous reduction reactor. Fuel element surface quality is affected by the remelt cycle used in casting ingots in heated molds. Pass schedules for the rolling of U flat strips were developed. Hollow U tubing was produced by the "Rockrite" process from cast hollow billits. Spectrographic procedures were developed for determining tungsten, zirconium, molybdenum, niobium, palladium, titanium, and thallium in U_3O_2. A rapid quantitative method was developed for the analysis of dysprosium, europium, gadolinium, holmium, lutecium, samarium, turbium, thulium, yttrium, and ytterbium in uranium ores and concentrates. (W.L.H.)

15675 NYO-1365
Mallinckrodt Chemical Works, St. Louis.
A PROCESS FOR THE RECOVERY OF URANIUM AND SCANDIUM FROM URANIUM REFINERY RAFFINATES. G. P. Lang, C. W. Kuhlman, and A. E. Ruehle. May 17, 1954. Decl. Mar. 15 1960. 45p. Contract W-14-109-eng-8. OTS.

A process for the removal of the residual uranium and scandium from refinery raffinates based on an extraction with 100% TBP, was developed. More than 99% of the uranium and 80% of the scandium was recovered. Preliminary cost estimates of this process were made. The scandium is produced by means of an ammonium thiocyanate extraction in the form of a 99.5% + scandium oxide. The accompanying yttria rare earths were obtained as a by-product. An account of the chemistry of the proposed process is given. (auth)

15676 NYO-5249
Mallinckrodt Chemical Works, St. Louis.
A REPORT ON THE "METAL E" [ENRICHED URANIUM] PROGRAM. W. A. Oppold. Oct. 25, 1951. Decl. Mar. 15, 1960. 21p. OTS.

The procedure of handling 8000 pounds of enriched UF_4 while processing it into U billets is described. The intensity of neutron and γ radiation in the plant during the processing operation was not significantly different from the intensity during normal operations. The α count was 15% higher than that of normal billets but was not detectable with regular instruments. In processing it was found that lowering the firing temperature from 1230 to 1130°F caused

yields in the reduction step to increase from 90 to 97%. All the derbies produced after the first batch were of exceptional surface quality. The N and Mg contents of the U billets were surprisingly low. The carbon content was high and the density was down but very consistent from top to bottom. (C.J.G.)

15677

THE PROCESSING OF URANIUM ORE CONCENTRATES AND RECYCLE RESIDUES AT SPRINGFIELDS. Ind. Chemist 36, 80-2(1960) Feb.

The Springfields plant process for the production of reactor-grade uranium, originally designed to work with impure uranium ore of less than 50% U_3O_8, was modified to work at high efficiencies with a wide range of raw materials. This is done by regulating the feed rate of the concentrates into the dissolver tanks which are held at 95°C. Thereafter, the process is continuous, and the plant is totally enclosed, thereby eliminating personnel protection problems. The steps of the process are described in some detail: (1) filtration of the concentrate slurries, (2) recovery cycle leaching, (3) recovery filtration, (4) purification by solvent extraction with 20 vol.% tributyl phosphate in kerosene, and (5) blending to obtain the desired isotope ratio. The product is then passed on to the denitration process. (D.L.C.)

15678

INVESTIGATIONS ON THE REDUCTION OF URANIUM(IV) FLUORIDE BY LIQUID ALUMINUM IN MOLTEN SALT MIXTURES. Włodzimierz Trzebiatowski, Aleksander Bogacz, and Irena Barycka (Polish Academy of Sciences, Wroclaw). Nukleonika 4, 591-8(1959). (In Polish)

The reduction of uranium (IV) compounds dissolved in molten salts, using excess liquid aluminum and resulting in aluminum-uranium alloys, was investigated. It was found that the reduction process in salt baths containing chlorides proceeds easily but is slow in fluoride salt baths. The chemical reactions for these salt mixtures are discussed and a reaction scheme to obtain liquid aluminum-uranium alloys containing 20 to 30 and more wt.% uranium is given. (auth)

15679

METHOD FOR PRODUCING THORIUM TETRACHLORIDE. E. A. Mason and C. M. Cobb (to U. S. Atomic Energy Commission). U. S. Patent 2,928,721. Mar. 15, 1960.

A process for producing thorium tetrachloride from thorium concentrate comprises reacting thorium concentrates with a carbonaceous reducing agent in excess of 0.05 part by weight per part of thoriferous concentrate at a temperature in excess of 1300°C, cooling and comminuting the mass, chlorinating the resulting comminuting mass by suspending in a gaseous chlorinating agent in a fluidized reactor at a temperature maintained between about 185°C and 770°C, and removing the resulting solid $ThCl_4$ from the reaction zone.

Separation Processes

15680 ANL-6131

Argonne National Lab., Lemont, Ill.

SPRAY FLUORINATION OF FUSED SALT AS A URANIUM RECOVERY PROCESS. A PRELIMINARY FEASIBILITY STUDY. J. D. Gabor, W. J. Mecham, A. A. Jonke, and W. A. Rodger. Mar. 1960. 39p. Contract W-31-109-eng-38. OTS.

Spray fluorination may be used to recover uranium as the volatile hexafluoride from molten fluorides by spraying the salt into a fluorine atmosphere. This dropwise liquid-gas contacting system was considered as a step in the fused-salt fluoride volatility process applied to zirconium-matrix fuels, with the possible advantage of avoiding corrosive conditions involved in sparging. Experimental equipment was developed and tests were made for heat and mass transfer. From the data obtained, process design calculations indicated that a satisfactory equipment design is possible. (auth)

15681 CF-59-9-47

Oak Ridge National Lab., Tenn.

A PRELIMINARY STUDY OF THE DYNAMICS OF SOLVENT EXTRACTION CASCADES. I. PROGRAM FOR DIGITAL AND ANALOG SIMULATION. O. L. Updike and M. E. Whatley. Sept. 15, 1959. 23p. OTS.

The dynamic behavior of solvent extraction systems is being studied. A generalized multistage cascade is the prototype for which mathematical models suitable for both digital and analog simulation are being developed. These can be "forced" by step, sinusoidal, random, or other perturbations to determine their transient performance. The chemical system considered is $UO_2(NO_3)-HNO_3-H_2O-TBP-Amsco$. The equations solved are of difference-differential form, arising from the material balance requirements of the system; and at each point in the time location plane an equilibrium relation interconnects concentrations of the two distributed components. The digital model is built around tabulated values of flows and concentrations, held in the fast memory of the ORACLE. Stage by stage, these are updated by computation from data of adjacent stages and preceding instants, with periodic output of tabulated results. The principal subprograms are one representing the interphase equilibrium and one which, by successive approximations, solves simultaneously the equilibrium relations with the material balance constraints. The analog model, less advanced, depends considerably on the digital results. The dynamic relations are easy to program. The complicated algebra of the equilibrium equations, however, uses equipment prodigally and degrades accuracy. (auth)

15682 CF-60-4-38

Oak Ridge National Lab., Tenn.

VPP—DESIGN CRITERIA FOR AN INSTALLATION TO REMOVE HYDROGEN FLUORIDE AND FLUORINE FROM THE CELLS 1 AND 2 VENTILATION GASES PRIOR TO FILTRATION. J. B. Ruch. Apr. 11, 1950. 19p. Contract [W-7405-eng-26]. OTS.

Criteria are presented for a horizontal cocurrent spray nozzle scrubbing system designed to remove fluorine and hydrogen fluoride from the 3000 cfm of ventilation air passing through the Volatility Pilot Plant. A reduction of fluorine concentration from 1520 to <2 ppm during a total release of 68 lbs, and a reduction of hydrogen fluoride concentration from 4090 to <1 ppm during a total release of 200 lbs, will adequately protect the Fiberglas media filters. Six scrubbing stages each containing four nozzle-throat spray units are needed with a 5 to 10% aqueous caustic potash recycle system pumping at a maximum rate of ~180 gal/min, with a range per nozzle from 3 to 7 gal/min. The scrubber will be 4 ft × 4 ft × ~25 ft, containing a de-entrainment section of baffles and demister. The associated ventilation system hardware, services, and instrumentation requirements are given. (auth)

15683 HDC-2087

[Hanford Works, Richland, Wash.]

INSTRUMENT SCHEMATIC FLOW DIAGRAMS AND SUPPLEMENTARY INFORMATION FOR THE REDOX PLANT. C. O. Clemetson. Apr. 16, 1951. Decl. Apr. 21, 1960. 24p. Contract [W-31-109-Eng-52]. OTS.

Drawings are included which are an instrument schematic flow diagram of the Redox process. All of the instruments to be used as a guide for manual control and instrumentation for automatic control are shown. For simplification all gang valve operators, radiation instruments, etc. were left off the diagram. All calibration constants, ranges, and scale values are shown. A brief description of the mechanics of the process which considers the instrument tie-in with the process is given. (auth)

15684 HW-14445

Hanford Works, Richland, Wash.

STEPWISE CALCULATION FOR THE DETERMINATION OF THE NUMBER OF TRANSFER UNITS IN COUNTER-CURRENT EXTRACTION COLUMNS. W. A. Burns. Sept. 12, 1949. Decl. Mar. 24, 1960. 7p. OTS.

A method is outlined for the stepwise calculation of the number of transfer units utilized in a given solvent extraction operation. The method gives a close approximation to the integrals of $dx/x - x^*$ and $dy/y^* - y$ between the limits of x_1 to x_2 and y_1 to y_2, respectively, as applied to packed and pulse columns. Use of the method results in a very appreciable saving in time of calculation with an error of 1.5% for the runs tested. The error tends to become smaller with increasing total numbers of transfer units involved. (auth)

15685 HW-20803

Hanford Works, Richland, Wash.

REMOVAL OF IODINE FROM AQUEOUS SOLUTIONS BY SPARGING. C. H. Holm. June 1951. Decl. May 9, 1960. 42p. Contract W-31-109-Eng-52. OTS.

The removal of iodine, in the iodide, iodine, or iodate forms, from uranium dissolver solutions by sparging was studied as a function of several variables. An increase in temperature or spargent flow-rate increased the rate of iodine removal in any of the oxidation states studied. Oxygen, air, and nitrogen were of increasing effectiveness in the order given when the iodine was added as iodine or iodate; the order was reversed for iodide. The iodine or iodate states were more rapidly evolved at a given spargent flow-rate when the solution was in contact with metallic uranium. Iodide removal was slower in the presence of metallic uranium. The evaluation of any of the three iodine oxidation states studied was not influenced by uranyl nitrate concentration between 1.5 and 2.2 M. Curves relating per cent iodine remaining after three hours of air sparging at 1.7 cc/m/ml to nitric acid concentration show broad minima for each oxidation state, ranging from 0.5 to 2.0, 0.1 to 0.7, and 0.0 to 0.5 M HNO_3 for iodide, iodine, and iodate, respectively. (C.J.G.)

15686 HW-21677(Del.)

Hanford Works, Richland, Wash.

PLUTONIUM EXTRACTION STAGE AND TRANSFER UNIT REQUIREMENTS. REDOX IA COLUMN. R. B. Lemon. Aug. 1, 1951. Decl. Mar. 24, 1960. 14p. Contract [W-31-109-Eng-52]. OTS.

Calculations were made of the number of equivalent stages and the number of transfer units required for Pu^{6+} extraction with a waste loss of 0.2% in the Redox IA column. (T.R.H.)

15687 HW-32316(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PILOT-PLANT STUDIES OF MERCURY-CATALYZED DISSOLVING OF ALUMINUM-JACKETED FUEL ELEMENTS. J. L. Bradford and K. L. Adler. July 1, 1954. Decl. Mar. 28, 1960. 22p. OTS.

A pilot plant has demonstrated that two-cut mercury-catalyzed dissolving of aluminum-jacketed uranium fuel elements is feasible and that the dissolution process may be readily controlled. A potential explosion hazard due to hydrogen and oxygen concentrations in the dissolver off-gas was found. The incorporation of this process in the Redox Process is discussed. (C.J.G.)

15688 HW-32823

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PROPOSED ALTERNATE DISSOLVING FLOWSHEETS FOR THE REDOX PLANT. M. H. Curtis and M. K. Harmon. Aug. 13, 1954. Decl. Apr. 21, 1960. 11p. Contract W-31-109-Eng-52. OTS.

Three different flowsheets utilizing the mercury-catalyzed reaction of aluminum with nitric acid are proposed for the Redox Process. All of these flowsheets eliminate NH_3 from the off-gases, permit shorter dissolver time cycles, and offer advantages of acid jacket removal. The flowsheets are shown in detail and compared with the current operation. One flowsheet produces H_2 in the off-gases but depends on gas treatment to prevent any hazardous conditions from arising. The second flowsheet results in no NH_3 or H_2 formation but requires the use of a jacket solution hold-up tank and achieves time economy by neutralizing the excess acid in the dissolved U cuts with acid-deficient $Al(NO_3)_3$ solution produced in jacket dissolving. The third flowsheet eliminates NH_3 and H_2 and does not require additional vessels other than the rinse tanks but discards a portion of the coating removal solution. The flowsheets retain their relative advantages when either up-draft or down-draft dissolving techniques are used. (auth)

15689 HW-58021

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRECIPITATION METHOD FOR THE RECOVERY OF PLUTONIUM FROM CHLORIDE SLAG AND CRUCIBLE—PROGRESS REPORT. R. W. Henkens. Oct. 30, 1958. Decl. Mar. 31, 1960. 8p. Contract W-31-109-Eng-52. OTS.

From laboratory-scale work, a flowsheet for the recovery of Pu from chloride slag and crucible was determined. The flowsheet is based on dissolving the slag and crucible in HNO_3, distilling away the major part of the acid, and adjusting the pH by adding NH_4OH so that any Pu which dissolves is precipitated, while the crucible materials are held in solution. All Pu is found with the residue. Dissolution of this residue produced solvent extraction feeds containing 15 g/l Pu. (W.L.H.)

15690 IDO-14223

American Cyanamid Co. Atomic Energy Div., Idaho Falls, Idaho.

LABORATORY STUDIES ON THE FILTRATION OF MTR DISSOLVER SOLUTIONS. CPP Start up Report No. 34. G. K. Cederberg. Feb. 18, 1953. Decl. Mar. 28, 1960. 26p. Contract AT(10-1)-177. OTS.

Twenty-four samples of a MTR dummy assembly were dissolved under various dissolving procedures. With the exception of one run, which had an estimated filter time of 40 hours for a 4 assembly equivalent batch, all others were successfully filtered in the laboratory scale equipment within 1½ hours. These runs indicated that solutions with good filtrability are obtained irrespective of the total dissolving time or the acid addition time for the batch, and that solutions having long filter times seldom occur. It is proposed that solutions having long filter times are possibly due to freak assemblies that have abnormally large

percentages of insolubles in them or due to a dissolver that has accumulated large quantities of insolubles from previous runs. A third dissolving of a batch of MTR assemblies was filtered successfully with sintered stainless steel filters. (auth)

15691 IDO-14242

American Cyanamid Co. [Atomic Energy Div]., Idaho Falls, Idaho.

MERCURY IN THE "25" PROCESS. Albert E. Erhard and Ralph H. Perkins. May 5, 1953. Decl. Mar. 28, 1960. 13p. Contract AT(10-1)-177. OTS.

The "25" Process streams were analyzed for mercury, and the distribution coefficients between aqueous and organic phases for the various columns were determined. It was concluded that there is no danger of mercury appearing in the final product when NP and MTR fuels are processed. Should mercury appear, the addition of powdered copper was found to be most effective in mercury removal. (C.J.G.)

15692 IDO-14377

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

AUTOMATIC SLUG CHARGER DESIGN PROPOSAL. H. Schneider. June 7, 1954. Decl. Mar. 28, 1960. 11p. Contract AT(10-1)-205. (CPP-54-57). OTS.

An automatic charging system is proposed in which slugs are automatically charged to a hydraulic transmission system for transfer from the slug storage basin to the chemical plant, disengaged, and placed in the dissolver. (C.J.G.)

15693 NYO-1468

Harshaw Chemical Co., Cleveland.

TECHNICAL REPORT ON THE EXPANDED HARSHAW TBP EXTRACTION PROCESS. D. A. Hammond. Apr. 29, 1954. Decl. Mar. 15, 1960. 99p. Contract W-7405-ENG-276. OTS.

The tributyl phosphate extraction system was successfully modified to make available increased production capacity. Studies were made in the pilot plant to clearly establish the extent of the necessary modifications to: maximum flow rates usable in the mixer-settler unit; optimum number of stages in the stripping section; effect of nitric acid concentration and effect of temperature on phase disengagement time in the stripping section; the effect of various concentrations of tributyl phosphate upon the concentration of uranium in the OK liquor; the effect of tributyl phosphate degradation products on the extraction, scrubbing, and stripping operations; reconditioning of impure solvent for extraction purposes; press cake solvent removal; and improved method for tributyl phosphate analysis. A discussion of these studies is presented, with data on analytical methods. (auth)

15694 JPRS-2615

CONCERNING THE PROBLEM OF DISTRIBUTION OF URANYL NITRATE BETWEEN AQUEOUS SOLUTIONS AND A NUMBER OF ETHERS AND ESTERS. V. M. Vdovenko and E. (Ye.) A. Smirnova. Translated from Radiokhimiya 1, 43-51(1959). 14p. OTS.

An investigation of uranyl nitrate distribution between water and a series of ethers and esters was conducted. Equilibrium constants were determined along with activity coefficients and apparent molar volumes. Equations expressing the uranyl nitrate distribution are included. (J.R.D.)

15695

SEPARATION OF TRACES OF URANIUM, NEPTUNIUM, PLUTONIUM, AND AMERICIUM BY ELECTROLYSIS. A. G. Samartseva. Atomnaya Energ. 8, 324-9(1960) Apr. (In Russian)

An electrolytic method is suggested for separating uranium, neptunium, plutonium, and americium traces from acid solutions. The yield is independent of anion concentration but dependent on pH. Conditions for quantitative separation of plutonium from various metallic admixtures are analyzed. The influence of iron was eliminated by the addition of oxalic acid. (tr-auth)

15696

CONTINUOUS ANALYZERS FOR PROCESSING IRRADIATED URANIUM. G. J. Alkire (General Electric Co., Richland, Wash.). Ind. Eng. Chem. 52, 481-3(1960) June.

Continuous analytical data are required in nuclear fuels reprocessing plants to evaluate instantaneous decontamination of fission products, concentration of uranium and plutonium in product streams, and amount of products to waste. Continuous analyzers developed and used at Hanford to help provide these data are as follows: light photometer, gamma ray absorptiometer, polarograph, pH monitor system, gamma scintillation detector, alpha particle detector, and neutron detector. The analyzers have provided continuous analytical data and improved control and efficiency. Plant tests can be run in a fraction of the previous time required, and tests can be made that could not be carried out previously. Although designed for inaccessible installations, the analyzers are readily adaptable to more conventional plants. (auth)

15697

CONTINUOUS ELECTROPHORETIC SEPARATIONS OF RADIOACTIVE RARE EARTH MIXTURES. I. SEPARATION OF $Ce^{144}-Tb^{160}-Tm^{170}$ AND $Ce^{144}-Eu^{152}-Yb^{169}$ IN 0.05 M LACTIC ACID. Z. Pučar and Z. Jakovac (Institute Rudjer Bošković, Zagreb). J. Chromatog. 3, 477-81(1960) May. (In English)

Radioautographs of the continuous electrophoretic separations and of the two-dimensional electrochromatographic separations of two mixtures, $Ce^{144}-Tb^{160}-Tm^{170}$ and $Ce^{144}-Eu^{152}-Yb^{169}$, in 0.05 M lactic acid are given. The activities of the separated rare earths are presented in a diagram. From the diagrams of activities and from the radioautographs it is evident that the separation of both rare earth mixtures into components was complete. The radioautographs of the discontinuous two-dimensional electrochromatographic separations show a relatively strong adsorption of Ce, Tb, and Eu on the filter paper. These elements give spots with comet-like tailings. The usefulness of the continuous electrophoretic separations of radionuclides for preparative carrier-free separations and radiometric qualitative and quantitative analyses is discussed. (auth)

15698

EXTRACTION OF THE LANTHANIDES WITH ACETYLACETONE. W. B. Brown, J. F. Steinbach, and W. F. Wagner (Univ. of Kentucky, Lexington). J. Inorg. & Nuclear Chem. 13, 119-24(1960) Apr. (In English)

Acetylacetone extracts the lanthanides from aqueous solution at pH values between four and six. The solubility and extractability of the rare earth acetylacetonates vary with the ionic radii of the central metal ions. Extraction of the lanthanides with acetylacetone is enhanced by the decrease in basicity of the central metal ion. While separations based on differences in the pH $\frac{1}{2}$ values of these chelates would be at best fractional, the variations in solubility and in the partition coefficients of these chelates make separations possible. (auth)

15699

PRELIMINARY STUDY OF URANIUM RECOVERY FROM PHOSPHORIC ACID. F. Habashi (Technische Hochschule, Vienna). J. Inorg. & Nuclear Chem. 13, 125-37(1960) Apr. (In German)

Uranium is extracted very rapidly from phosphoric acid solutions by octyl pyro phosphoric acid diluted with n-hexan. From dilute phosphoric acid solutions, high distribution coefficients are observed, whereas from concentrated solutions low distribution coefficients are observed. Decreasing the hydrogen ion concentration from equally concentrated phosphate solutions increases greatly the distribution coefficients. These facts as well as the other experimental results, such as changing the distribution coefficient by changing the phosphoric acid concentration and the uranium concentration in the aqueous phase or through changing the quantity of the solvent, are discussed. The different factors influencing the distribution coefficients are attributed to the different uranyl phosphate complexes existing in the aqueous phase with respect to the pH and the phosphoric acid concentration, and a complex between the uranyl ion and the solvent in the organic phase. (auth)

15700

EXTRACTION OF THORIUM(IV) BY DI ESTERS OF ORTHOPHOSPHORIC ACID, $(GO)_2PO(OH)$. D. F. Peppard, G. W. Mason, and S. McCarty (Argonne National Lab., Lemont, Ill.). J. Inorg. & Nuclear Chem. 13, 138-50(1960) Apr. (In English)

The extraction of tracer-level Th(IV) into solutions of $(GO)_2PO(OH)$ in toluene as carrier solvent from aqueous perchlorate, chloride, and nitrate solutions was investigated. $(GO)_2PO(OH)$ is symbolized as HDGP, where G is 2-ethylhexyl (EH), and para(1,1,3,3-tetramethyl butyl) phenyl (OΦ). The distribution ratio, K, is shown to vary directly with the third power of the stoichiometric concentration of extractant in the solvent phase (third-power solvent dependency) and inversely with the fourth power of the stoichiometric hydrogen ion concentration in the aqueous phase (inverse fourth-power acid dependency) for the di[para(1,1,3,3-tetramethyl butyl)phenyl] phosphoric acid systems. The di(2-ethylhexyl) phosphoric acid systems display a more complicated behavior, the K being third-power solvent dependent in each of the aqueous systems, but inverse third-power acid dependent in the nitrate systems and inverse fourth-power acid dependent in the perchlorate and chloride systems at low acidities ranging to nearly inverse third-power acid dependent at high acidities. The extracted entities are formulated as $Th(DO\Phi P)_2[H(DO\Phi P)_2]_2$, $Th(DEHP)_2[H(DEHP)_2]_2$ and $Th(DEHP)[H(DEHP)_2]_2X$, where X is nitrate, chloride and probably perchlorate, and tentatively postulated as co-ordination complexes of co-ordination number six. The effect of the corresponding mono esters as contaminants is discussed. (auth)

15701

THE EFFECTS OF ALTERING ALKYL SUBSTITUENTS IN TRIALKYL PHOSPHATES ON THE EXTRACTION OF ACTINIDES. T. H. Siddall, III (E. I. du Pont de Nemours & Co., Aiken, S. C.). J. Inorg. & Nuclear Chem. 13, 151-5 (1960) Apr. (In English)

The extraction of neptunium(VI), plutonium(VI), neptunium(IV), and plutonium(IV) nitrates by trialkyl phosphates follows the same general pattern as the extraction of uranyl nitrate when the alkyl groups are varied. However, the extraction of thorium nitrate is greatly depressed when bulky alkyl groups are introduced into the extractant molecule. This behavior of thorium nitrate appears to be due to the fact that three extractant molecules are co-ordinated to each thorium atom in the prevalent mode of extraction. Only two molecules of extractant are required for the other actinides. (auth)

15702

THE EXTRACTION OF MINERAL ACIDS BY TRI-n-BUTYL PHOSPHATE (TBP). E. Hesford and H. A. C. McKay (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 156-64(1960) Apr. (In English)

The physical chemistry of the extraction of HCl, HNO_3, H_2SO_4, $HClO_4$, and HF from aqueous solution by tri-n-butyl phosphate (TBP) was studied. Electrical conductivity and viscosity measurements show that $HClO_4$ is a strong electrolyte in TBP, but that the other acids only ionize to a limited extent; the ionization constants of HCl, HNO_3, and H_2SO_4 (first dissociation) are all equal to about 9×10^{-5}. The partition results are in accord with these conclusions, and indicate also the formation of HCl·TBP, HNO_3·TBP, H_2SO_4·TBP, and $HClO_4$·TBP; perchloric acid appears moreover to yield higher solvates in addition to the monosolvate. The water content of the TBP phase increases with acid concentration in all cases except that of HNO_3, and this may help to explain certain differences in viscosity and conductivity which appear at high acidities. (auth)

15703

THE EXTRACTION OF URANYL PERCHLORATE BY TRI-n-BUTYL PHOSPHATE (TBP). E. Hesford and H. A. C. McKay (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 165-73(1960). Apr. (In English)

$UO_2(ClO_4)_2$ differs from $UO_2(NO_3)_2$ in being appreciably ionized and hydrated in TBP. It resembles $UO_2(NO_3)_2$ in forming a di-solvate, $UO_2(ClO_4)_2$·2TBP, at least under one set of conditions. Most features of its extraction by TBP from aqueous solutions are explicable by means of the theory that has been developed for nitrate systems, though differences in the values of the parameters lead to important differences in behavior. Interesting and at present inadequately explained changes occur in the absorption spectrum of $UO_2(ClO_4)_2$ in TBP under different conditions. (auth)

15704

THE EXTRACTION OF NIOBIUM(V) FROM NITRIC ACID SOLUTION BY TRI-n-BUTYL PHOSPHATE (TBP). C. J. Hardy and D. Scargill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 174-80(1960) Apr. (In English)

Stable and reproducible solutions of $<10^{-7}$ M Nb in 2 to 12 M HNO_3 were prepared and the extraction of niobium from these solutions by TBP was studied. The niobium species in nitric acid solution are interpreted as a series of hydroxonitrato complexes of the hypothetical Nb^{5+} ion in slow equilibrium with solvent-inextractable, and possibly polymeric, species. (auth)

15705

PURE COLUMBIUM AND TANTALUM OXIDES BY LIQUID-LIQUID EXTRACTION. Carl W. Carlson and Ralph H. Nielsen (Wah Chang Corp., Albany, Ore.). J. Metals 12, 472-5(1960) June.

A system for the plant-scale separation of Nb and Ta in ores and preparation of their oxides was developed and put into operation at the Albany, Oreg., plant of Wah Chang Corp. Its principle is the extraction of the acid fluorides of Ta from a H_2SO_4–HF aqueous phase by a hexone phase,

subsequent precipitation of the separated Nb and Ta by 28% NH_3, and their calcination to the oxides. The mixing of the phases is done in three pulse-plate column units of all-polyethylene construction. The equipment and steps in the plant-scale operation are described in detail, and flow sheets are given for both pilot and plant operations. A table of typical analyses of impurities in the Nb and Ta oxides is presented; in no case did the content of any impurity exceed 600 ppm. Oxides of Nb and Ta of the same order can be produced from ores having a Nb/Ta ratio from 4:1 to 1:4 and a combined Nb-Ta oxide content of more than 30%. (D.L.C.)

15706

DEJACKETING PELLETS USING RF HEAT. B. J. Massey (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 7, 478-9(1960) May.

Pellets of Be_3N_2 are irradiated in Al cans to produce C^{14}. Removing these pellets from the cans is difficult because they swell against the wall. The method evolved for dejacketing the pellets consisted in using an rf heater and a work coil made of copper tubing wound around a quartz tube. The can is placed in the coil and in ~3 min the bottom of the can is melted. Since the can has been heated throughout, the Al expands and allows the pellets to fall free. (W.L.H.)

15707

SEPARATION OF PLUTONIUM FROM NEUTRON-IRRADIATED URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 834,529. May 11, 1960.

A solvent extraction method is given for separation of Pu from irradiated U. In the example given, a solution of U, Pu, fission products, and lithium nitrate was extracted with diethyl ether. The aqueous phase was then oxidized and a second extraction carried out. 86% of the Pu was recovered as PuO_2^{2+}. (T.R.H.)

15708

IMPROVEMENTS IN OR RELATING TO THE RECOVERY OF PLUTONIUM FROM ORGANIC SOLVENTS. William Douglas Jamrack and Harold Augustus Walker (to United Kingdom Atomic Energy Authority). British Patent 834,531. May 11, 1960.

A simple, inexpensive process for recovering Pu in solid form from organic solvents is described. Oxalic acid precipitates the Pu in a HNO_3—solvent solution. In the example, CaF_2 slag was dissolved in HNO_3—$Al(NO_3)_3$ solution and extracted with TBP in kerosene. The extract was treated with 0.25 M oxalic acid solution with stirring for 30 minutes. The aqueous oxalate phase containing the Pu was collected and washed. (T.R.H.)

15709

IMPROVEMENTS IN OR RELATING TO RECOVERY OF RADIOACTIVE CAESIUM. Harold Augustus Walker and Thomas Elwyn Edwards (to United Kingdom Atomic Energy Authority). British Patent 835,043. May 18, 1960.

A method is given for converting cesium phosphotungstate precipitated from fission product solutions to more useful compounds. In an example, an 8 N HNO_3 solution of fission products was treated with 12-tungstophosphoric acid to precipitate Cs. The precipitate was collected, washed, dissolved in NaOH, and re-precipitated. The precipitate was then dissolved in NH_4OH and passed through an ion-exchange column containing De-acidite FF in hydroxide form. The Cs hydroxide resulting was neutralized with H_2SO_4 and dried. (T.R.H.)

15710

CONCENTRATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 835,212. May 18, 1960.

A process for concentration of Pu by co-precipitation on Nb_2O_5 and LaF_3 is described. In the example given, LaF_3 and Pu are precipitated by HF from a processed HNO_3 solution of fission products to which $La(NO_3)_3$ had been added. The precipitate was washed with NaOH and treated with 10 N KOH 2 hours at 75 to 100°C. The hydroxide precipitate was washed and dissolved in concentrated HNO_3 with $Zr(NO_3)_4$, pH adjusted to Z, and Nb_2O_5 added to a concentration of 0.005 μ Nb ion. The Nb_2O_5 carried Pu down with it. This precipitate was washed with dilute H_2SO_4 to remove La, and another HF precipitation carried down the remaining La and 81% of the original Pu. (T.R.H.)

15711

IMPROVEMENTS IN OR RELATING TO LIQUID-LIQUID CONTACTING APPARATUS. Maurice Charles Tanner (to United Kingdom Atomic Energy Authority). British Patent 835,282. May 18, 1960.

A mixer-settler is described. A square trough is divided into alternate mixer and settler compartments, and the dividers have angled slots and overflow weirs arranged so that the light and heavy phases move properly. (T.R.H.)

15712

REMOVAL OF CHLORIDE FROM AQUEOUS SOLUTIONS. M. L. Hyman and J. E. Savolainen (to U. S. Atomic Energy Commission). U. S. Patent 2,919,972. Jan. 5, 1960.

A method is given for dissolving reactor fuel elements in which the uranium is associated with a relatively inert chromium-containing alloy such as stainless steel. An aqueous mixture of acids comprising 2 to 2.5 molar hydrochloric acid and 4 to 6 molar nitric acid is employed in dissolving the fuel element. In order to reduce corrosion in subsequent processing of the resulting solution, chloride values are removed from the solution by contacting it with concentrated nitric acid at an elevated temperature.

15713

PRODUCTION OF PURIFIED URANIUM. L. Burris, Jr., J. B. Knighton, and H. M. Feder (to U. S. Atomic Energy Commission). U. S. Patent 2,922,711. Jan. 26, 1960.

A pyrometallurgical method for processing nuclear reactor fuel elements containing uranium and fission products and for reducing uranium compounds to metallic uranium is reported. If the material processed is essentially metallic uranium, it is dissolved in zinc, the solution is cooled to crystallize UZn_9, and the UZn_9 is distilled to obtain uranium free of fission products. If the material processed is a uranium compound, the solvent is an alloy of zinc and magnesium and the remaining steps are the same.

15714

PROCESS OF RECOVERING ZIRCONIUM VALUES FROM HAFNIUM VALUES BY SOLVENT EXTRACTION WITH AN ALKYL PHOSPHATE. D. F. Peppard (to U. S. Atomic Energy Commission). U. S. Patent 2,923,607. Feb. 2, 1960.

A process of separating hafnium nitrate from zirconium nitrate contained in a nitric acid solution by selectively extracting the zirconium nitrate with a water-immiscible alkyl phosphate is reported.

15715

METHOD AND MEANS FOR ELECTROLYTIC PURIFICATION OF PLUTONIUM. C. W. Bjorklund, R. Benz, W. J. Maraman, J. A. Leary, and K. A. Walsh (to U. S. Atomic Energy Commission). U. S. Patent 2,923,670. Feb. 2, 1960.

The technique of electrodepositing pure plutonium from

a fused salt electrolyte of $PuCl_3$ and alkali metal halides is described. When an iron cathode is used, the plutonium deposit alloys therewith in the liquid state at the 400 to 600°C operating temperature, such liquid being allowed to drip through holes in the cathode and collect in a massive state in a tantalum cup. The process is adaptable to continuous processing by the use of depleted plutonium fuel as the anode; good to excellent separation from fission products is obtained with a Pu–Fe "fissium" anode containing representative fractions of Ce, Ru, Zr, La, Mo, and Nb.

15716

SOLVENT EXTRACTION PROCESS FOR PLUTONIUM. H. H. Anderson and L. B. Asprey (to U. S. Atomic Energy Commission). U. S. Patent 2,924,506. Feb. 9, 1960.

A process of separating plutonium in at least the tetravalent state from fission products contained in an aqueous acidic solution by extraction with alkyl phosphate is reported. The plutonium can then be back-extracted from the organic phase by contact with an aqueous solution of sulfuric, phosphoric, or oxalic acid as a complexing agent.

15717

METHOD OF SEPARATING PLUTONIUM. H. G. Heal (to U. S. Atomic Energy Commission). U. S. Patent 2,925,322. Feb. 16, 1960.

A method of separating plutonium from aqueous nitrate solutions of plutonium, uranium, and high beta activity fission products is given. The pH of the aqueous solution is adjusted between 3.0 to 6.0 with ammonium acetate, ferric nitrate is added, and the solution is heated to 80 to 100°C to selectively form a basic ferric plutonium-carrying precipitate.

15718

CATIONIC EXCHANGE PROCESS FOR THE SEPARATION OF RARE EARTHS. G. R. Choppin, S. G. Thompson, and B. G. Harvey (to U. S. Atomic Energy Commission). U. S. Patent 2,925,431. Feb. 16, 1960.

A process for separating mixtures of elements in the lanthanum and actinium series of the periodic table is described. The mixture of elements is dissolved in 0.05 M HCl, wherein the elements exist as tripositive ions. The resulting solution is then transferred to a column of cationic exchange resin and the column eluted with 0.1 to 0.6 M aqueous ammonium alpha hydroxy isobutyrate solution of pH 3.8 to 5.0. The use of ammonium alpha hydroxy isobutyrate as an eluting agent results in sharper and more rapid separations than previously obtainable with eluants such as citric, tartaric, glycolic, and lactic acids.

15719

CONCENTRATION OF Pu USING AN IODATE PRECIPITATE. B. A. Fries (to U. S. Atomic Energy Commission). U. S. Patent 2,926,067. Feb. 23, 1960.

A method is given for separating plutonium from lanthanum in a lanthanum fluoride carrier precipitation process for the recovery of plutonium values from an aqueous solution. The carrier precipitation process includes the steps of forming a lanthanum fluoride precipitate, thereby carrying plutonium out of solution, metathesizing the fluoride precipitate to a hydroxide precipitate, and then dissolving the hydroxide precipitate in nitric acid. In accordance with the invention, the nitric acid solution, which contains plutonium and lanthanum, is made 0.05 to 0.15 molar in potassium iodate, thereby precipitating plutonium as plutonous iodate and the plutonous iodate is separated from the lanthanum-containing supernatant solution.

15720

REGENERATION OF REACTOR FUEL ELEMENTS. W. E. Roake and W. L. Lyon (to U. S. Atomic Energy Commission). U. S. Patent 2,930,738. Mar. 29, 1960.

A process of concentrating by electrolysis the uranium and/or plutonium of an aluminum alloy containing these actinides after the actinide has been partially consumed by neutron bombardment in a reactor is given. The alloy is made the anode in a system having an aluminum cathode and a cryolite electrolyte. Electrolysis from 22 to 26 ampere-hours removes a sufficient quantity of aluminum from the alloy to make it suitable for reuse.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

15721 AAEC/E-35

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.

POST-IRRADIATION FACILITIES AT LUCAS HEIGHTS. D. R. Ebeling and B. S. Hickman. Apr. 1959. 9p.

The post-irradiation facilities being constructed at Lucas Heights are described, and the equipment which will be available in these facilities is discussed. (auth)

15722 DEGIS-29(W)

United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., England.

BIBLIOGRAPHY ON AEROSOLS. Information Memorandum. P. Lamond and J. Bryce. July 13, 1959. 18p.

A bibliography of unclassified references on removal of entrained particles from evaporator vapor streams is presented. Sources searched were Nuclear Science Abstracts, 1947 to June 1959, and Chemical Abstracts, 1946 to 1958. (J.R.D.)

15723 EES-820052

Naval Engineering Experiment Station, Annapolis.

A BIBLIOGRAPHY AND ABSTRACTS OF REPORTS ON RESILIENT MOUNTINGS. Paul J. Shovestul, comp. Mar. 25, 1959. 68p. Project No. NS-713-017.

A biographical review containing abstracts of Engineering Experiment Station reports that have been published on development, investigation, and evaluation of resilient isolation mountings. 64 abstracts. (J.R.D.)

15724 JPL-TR-32-1

California Inst. of Tech., Pasadena. Jet Propulsion Lab.

EXTERNALLY PRESSURIZED SPHERICAL GAS BEARINGS. J. H. Laub and R. H. Norton. Apr. 1, 1960. 15p.

Spherical gas-lubricated bearings are of considerable interest in applications requiring a pivoting or rotating support with three degrees of freedom, for instance in attitude control simulators of space vehicles. An analytical and experimental study of externally pressurized spherical gas bearings with orifice regulation is presented along with the experimental findings which are in good agreement with the predictions of the viscous flow theory. (auth)

15725 NAA-SR-Memo-4413(Rev.1)

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DESIGN OF 3400 gpm 40 psi LINEAR INDUCTION PUMP FOR THE 250 MWE OVERFLOW REACTOR. R. S. Baker. July 16, 1959. 14p. OTS.

Design of a linear induction pump for the 250 Mwe advanced sodium graphite reactor is described. The pump develops 3400 gpm at 40 psi using sodium at 625°F. (J.R.D.)

15726 PWAC-292

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

EXPERIMENTAL CONTROL FOR TP-1 LIQUID METAL TURBOPUMP. P. V. Naples and S. F. Gladczuk. Apr. 29, 1960. 23p. Contract NOas-58-662-c.

The initial tests of an experimental liquid metal turbopump control to determine the compliance of this system with its requirements were undertaken. Current results established the validity of the theory, thus justifying further development of system components. Recommendations for modifications and further testing are included. (J.R.D.)

15727 SCR-177

Sandia Corp., Albuquerque, N. Mex.

MULTIPLE-SOURCE SCHLIEREN SYSTEM (TRANSONIC WIND TUNNEL). H. R. Spahr and R. E. Kyrlach. Apr. 1960. 8p. OTS.

A flow visualization system was developed for the Sandia Corporation 12 × 12-inch transonic blowdown wind tunnel. The arrangement comprises a multiple-source schlieren system with sharp focusing properties to keep the perforated plexiglas side walls out of focus. The detailed mechanical design of the schlieren system is not completed. However, a bench-type setup representative of the final system has been made at the wind tunnel. The system is shown and each component is discussed briefly. (auth)

15728 SCTM-76-60(14)

Sandia Corp., Albuquerque, N. Mex.

HIGH-VACUUM TECHNIQUES. G. L. Krieger. Mar. 4, 1960. 25p. OTS.

Considerations of high-vacuum technology covered in this report are: (1) basic design considerations of vacuum systems; (2) high-vacuum processes, such as vacuum firing, vacuum evaporation, sputtering, and tube processing; (3) handling of high-vacuum equipment; (4) choice of high-vacuum materials; and (5) methods of leak detection. Emphasis is placed on practical application and on the precautions necessary to achieve ultrahigh vacuum. (auth)

15729

THE ROLE OF REDOX PROCESSES WHEN OXIDES OF URANIUM DISSOLVE IN ACIDS. G. M. Nesmeyanova and G. M. Alkhazashvili. Atomnaya Energ. 8, 330-5(1960) Apr. (In Russian)

The oxidation and dissolution processes associated with mixed oxides of uranium in acid media and the influence of divalent iron are analyzed. The strengths of various oxidizers are compared in relation to uranium. It was found that the oxidation of tetravalent uranium is not determined by a single sign normal redox potential. The incomplete separation of uranium by weak nitric and sulfuric acids from solutions containing large amounts of iron ions is caused by complexing between Fe^{2+}, SO_4^{2-}, and NO_3^- ions. (tr-auth)

15730

ELASTIC-PLASTIC THERMAL STRESSES IN TUBES SUBJECTED TO UNIFORM HEAT GENERATION. EVALUATION OF EXPERIMENTAL RESULTS OBTAINED USING GRAPHITE TUBES. T. Kammash (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng. 7, 425-34(1960) May.

The elastic-plastic deformation of a tube subjected to radially uniform heat generation is considered using Tresca's yield function, its associated flow rule, and a linear work-hardening law. The tube is assumed to be in the state of plane strain and all the elastic and thermal parameters are taken to be temperature independent. For a uniform heat source Q, which increases monotonically with time and which has an insulated inner surface, yielding commences at the inner boundary and propagates outward upon further thermal loading. Immediately after initiation of yield, a plastic region (inner) and an elastic region (outer) are formed with the tangential stress as the intermediate principal stress in both regions. The maximum strength of a heat source, Q_M, to which a tube may be subjected is taken to correspond to that value of Q which makes the tube almost entirely plastic. This value of Q is computed for several graphite tubes of different thicknesses and then compared with an experimentally obtained Q_F which corresponds to total failure (fracture) of these tubes. A value of approximately 2.5 is obtained for Q_F/Q_M for tubes of moderate thicknesses. Furthermore, the ratio Q_F/Q_M remains practically constant as tube thickness increases. Agreement between theory and experiment especially in depicting the dependence of failure load on tube thickness and temperature gradient is considered excellent in light of the many assumptions made. The application of this theory to the design of nuclear reactor fuel elements is also pointed out. (auth)

15731

IMAGE FURNACE RESEARCH. C. P. Butler (U.S. Naval Radiological Defense Lab., San Francisco). p.7-20 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Some heat transfer experiments which were studied with image furnaces are briefly described. (J.R.D.)

15732

HIGH PRESSURE METHODS. H. Tracy Hall (Brigham Young Univ., Provo, Utah). p.145-56 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Devices are discussed which illustrate useful ideas for obtaining pressures greater than are possible with ordinary simple piston and cylinder apparatus. These include the principal of massive support, relative motion obtained by means of a compressible gasket, relative motion obtained by elastic distortion, relative motion by means of new designs, multistage effects obtained within a single stage, and the use of solids to transmit pressure. (J.R.D.)

15733

IMPROVEMENTS IN OR RELATING TO FLUID CIRCUITS, e.g., OF NUCLEAR REACTORS. Samuel Brittan Hosegood, Brian Edward Puffett, and Joseph Henry Swain (to United Kingdom Atomic Energy Authority). British Patent 835,145. May 18, 1960.

An arrangement is described for components in a circulating system whereby components may be removed without disconnecting pipe joints. The arrangement is particularly useful in radioactive areas where remote manipulation of components is necessary. A recess is provided for a pump, for example, with inlet and outlet connections. The pump is enclosed in a container with fittings which line up with the input and output connections of the recess when the pump container is lowered into the recess. The pump container seals against the top of the recess, providing an enclosed space through which the fluid is pumped. (T.R.H.)

15734

VACUUM TRAP. H. S. Gordon (to U. S. Atomic Energy Commission). U. S. Patent 2,904,665. Sept. 15, 1959.

An improved adsorption vacuum trap for use in vacuum systems was designed. The distinguishing feature is the placement of a plurality of torsionally deformed metallic fins within a vacuum jacket extending from the walls to the

central axis so that substantially all gas molecules passing through the jacket will impinge upon the fin surfaces. The fins are heated by direct metallic conduction, thereby obtaining a uniform temperature at the adsorbing surfaces, so that essentially all of the condensible impurities from the evacuating gas are removed from the vacuum system.

15735

TWO-WAY FREEZE VALVE. K. D. Lantz and P. M. Clark (to U. S. Atomic Energy Commission). U. S. Patent 2,919,710. Jan. 5, 1960.

A valve for closing off the flow of radioactive and corrosive gases and liquids or mixtures thereof and forming a leak tight barrier is described. This valve has no mechanical moving parts which would require design to close tolerances and retention of the usual seal tightness. Instead, there is provided a cavity in which a fusible metal is contained. Heating and cooling are provided to exercise control over the state of the metal. Baffle chambers are utilized to separate the molten fusible metal from the gas or liquid which is being passed through and return the molten metal to its cavity.

15736

FUEL HANDLING MECHANISM. L. J. Koch and E. Hutter (to U. S. Atomic Energy Commission). U. S. Patent 2,924,483. Feb. 9, 1960.

A remotely operable handling device specifically adapted for the handling of vertically disposed fuel rods in a nuclear reactor was developed. The device consists essentially of an elongated tubular member having a gripping device at the lower end of the pivoted jaw type adapted to grip an enlarged head on the upper end of the workpiece. The device includes a sensing element which engages the enlarged head and is displaced to remotely indicate when the workpiece is in the proper position to be engaged by the jaws.

15737

ROTARY SWITCH. J. P. E. Watterberg (to U. S. Atomic Energy Commission). U. S. Patent 2,928,910. Mar. 15, 1960.

A compact rotary-type switch was designed wherein an insulating shell carries circumferentially spaced contacts exposed to its interior and also carries, on a re-entrant portion, resilient contact arms having contact portions aligned with and biased toward the spaced contacts. A dielectric rotor with a movable wall between the contacts and contact arms has an aperture that may be turned into or out of registry with the contacts so as to establish or interrupt circuits.

Heat Transfer and Fluid Flow

15738 KAPL-M-S3G-RES-72

Knolls Atomic Power Lab., Schenectady, N. Y.

METHOD FOR DETERMINING FUEL ELEMENT SURFACE TEMPERATURE IN THE HOT CHANNEL CONTAINING BULK STEAM; WALLS FILM BLANKETED WITH SUPERHEATED VAPOR. J. E. Kalinowski. Mar. 29, 1960. 17p. Contract W-31-109-Eng-52. OTS.

An analysis of burnout correlations is presented in which the limiting condition is assumed to be the fuel element temperature in the hot channel as related to the coolant flow through the reactor. (J.R.D.)

15739 NASA-TN-D-130

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

USE OF A THEORETICAL FLOW MODEL TO CORRELATE DATA FOR FILM COOLING OR HEATING AN ADIABATIC WALL BY TANGENTIAL INJECTION OF GASES OF DIFFERENT FLUID PROPERTIES. James E. Hatch and S. Stephen Papell. Nov. 1959. 43p. (AD-227897). OTS.

An equation is derived, by use of a simplified theoretical flow model, that predicts the temperature of a film-cooled wall within 5% for a range of cooling effectiveness from approximately 0.2 to 1.0. The equation is easily solved for required coolant flow rate by a simple iteration process involving continuity. Both helium and air were used as the coolant gas. The range of variables covered by the data is as follows: main-gas-stream temperature, 502 to 1965° R; main-gas-stream velocity, 104 to 1040 ft/sec; velocity ratio V_g/V_c, 0.45 to 33.3; injected gas temperature, 530 to 980° R; and coolant slot height, 0.063 to 0.50 inch. (auth)

15740 UCRL-9112

California. Univ., Berkeley. Lawrence Radiation Lab.

LONGITUDINAL DISPERSION IN TWO-PHASE CONTINUOUS-FLOW OPERATIONS: SOLUTION AND TABLES FOR COCURRENT FLOW. Terukatsu Miyauchi, Alice K. McMullen, and Theodore Vermeulen. Mar. 14, 1960. 24p. Contract W-7405-eng-48. OTS.

The mathematical derivation of solutions for longitudinal dispersion in chemical-process equipment is extended to the case of cocurrent flow. The extent of completion of the process, in dimensionless form, is given as an analytical function of rates of dispersion in the two phases, over-all heat- or mass-transfer coefficient, partition coefficient, rates of fluid flow, and fractional height in the equipment. Numerical results for a large number of typical conditions are given in tabular form. (auth)

15741 NP-tr-431

HEAT TRANSMISSION IN BAFFLED AND UNBAFFLED FLUIDISED SOLID-GAS SYSTEMS. L. Massimilla, S. Bracale, and A. Cabella. Translated by R. S. Pease (U.K.A.E.A. Atomic Energy Research Establishment) from Ricerca sci. 27, 1853-64(1957). 42p. (Handwritten MS. copy). JCL.

Results of a series of heat transmission tests on air-fluidized baffled and unbaffled solid-gas systems are presented. The tests were performed on beds of variable height, consisting of 0.7 mm glass beads and fluidized by an airstream of varying velocity. In all tests the heat transfer coefficients were determined. The values of heat transfer coefficients along the c and m axis, relating to the unbaffled fluidization tests, are then compared with those relating to the baffled fluidization tests. This comparison shows that the values of the heat transfer coefficients, both in the baffled and in the unbaffled systems, are practically the same. (auth)

15742

HEAT TRANSFER TO SODIUM AT SMALL VALUES OF REYNOLDS NUMBER. M. S. Priogov., Atomnaya Energ. 8, 367-8(1960) Apr. (In Russian)

Heat transfer to sodium from round copper tubes (ID = 28 mm; δ = 4 mm) was measured in the Reynolds number range 17 to 416. The data, developed with the criterion Nu = f(Re), are plotted and correlated with published data. Agreement with the Martinelli-Lyon formula was obtained. The results do not confirm the postulations on sharp drops in heat transfer at small Re numbers. (R.V.J.)

15743

DEVELOPMENT OF A DIAGRAM FOR CALCULATING NATURAL WATER CIRCULATION IN WATERTUBE BOILERS AND BOILING WATER REACTORS. K. Jaroschek and F. Brandt (Technische Hochschule, Darmstadt, Ger.). Brennstoff-Wärme-Kraft 12, 189-96 (1960) May. (In German)

To avoid the time-consuming calculations for water circulation in watertube boilers a general equation has been developed which includes all friction coefficients and parameters, the equation being based on those for the advance velocity of water vapor in riser tubes. The equation was evaluated for all relevant parameters with the electronic calculating unit IBM 650 and presented in a diagram. Because the advance velocity has less influence on water-circulation than has been assumed so far, the diagram which, because of the original equation used, can be applied to tubes of 58 mm interior diameter only, is also applicable with reasonable accuracy to other tube diameters. However, for this purpose, the friction coefficients of the tubes will have to be known and they are going to be investigated for mixed flow over a wide range of diameters. The water circulation diagram can also be applied to boiling water reactors but this requires knowledge of the resistance of the fuel elements (influence of the element supports). The diagram makes it possible to obtain, with little calculating effort, an indication of the influence of all essential parameters. (auth)

15744

EFFECT OF NATURAL CONVECTION ON TRANSITION TO TURBULENCE IN VERTICAL PIPES. George F. Scheele, Edward M. Rosen, and Thomas J. Hanratty (Univ. of Illinois, Urbana). Can. J. Chem. Eng. 38, 67-73(1960) June.

The effect of natural thermal convection on transition to a disturbed flow in a heat transfer section of a vertical pipe was investigated. The transition is related to the distortions of the velocity profile caused by natural convection. When natural convection is in the direction of forced flow the transition appears to occur through the growth of small disturbances. Transition occurs suddenly when natural convection is opposite the direction of forced flow and it appears to be associated with a separation of the flow at the wall. (auth)

15745

MECHANICAL DESIGN OF HEAT EXCHANGERS. A. J. Gram (Babcock & Wilcox Co., Barberton, Ohio). Ind. Eng. Chem. 52, 468-73(1960) June.

The wide range of applications of heat exchangers in the chemical industry led to a variety of constructions to accommodate the many types of fluids and processes. To fit the majority of cases, standard tube-and-shell heat exchangers were developed by the industry, and the process of standardization is continuing to reduce exchanger first costs, implement rapid delivery, and permit interchangeability of parts. For unusual conditions and to take advantage of constructions other than tube-and-shell, a second class of "special types" of heat exchangers developed. (auth)

15746

THERMAL DESIGN OF HEAT EXCHANGERS. Donald S. Morton (M. W. Kellogg Co., New York). Ind. Eng. Chem. 52, 474-8(1960) June.

The basic thermal design must be correlated with the mechanical design and application of heat exchangers. The optimum thermal design must be operable as well as being adaptable to a sound and economical mechanical design. The three basic classifications or modes of heat transmission are conduction, radiation, and convection. The most common applications of heat transfer are a combination of one or more of these basic modes—for example, forced convection in a shell-and-tube exchanger. To illustrate the procedure involved when rating a shell-and-tube heat exchanger, a typical thermal design calculation is presented. (auth)

15747

HEAT TRANSFER FOR LAMINAR FLOW IN DUCTS WITH ARBITRARY TIME VARIATIONS IN WALL TEMPERATURE. Robert Siegel (National Aeronautics and Space Administration, Lewis Research Center, Cleveland). J. Appl. Mechanics 27, 241-9(1960) June.

An analysis is made for laminar forced-convection heat transfer in a circular tube or a parallel plate channel whose walls may undergo arbitrary time variations in temperature. The time-varying process can begin from an already established steady-state situation with heat transfer taking place, or the fluid and walls can be initially at the same uniform temperature. The fluid velocity distribution is fully developed and unchanging with time. At any instant during the transient the wall temperature is spatially uniform, that is, all portions of the wall simultaneously undergo the same temperature-time variation. The greater part of the analysis is concerned with the response to a step change in wall temperature, and the time required to reach steady state is given for this type of transient. Then the results are generalized to apply for arbitrary variations with time. (auth)

15748

STEAM SLIP—THEORETICAL PREDICTION FROM MOMENTUM MODEL. S. Levy (General Electric Co., San Jose, Calif.). J. Heat Transfer 82, 113-24(1960) May.

Theoretical equations governing slip effects in forced circulation of boiling water are derived. The equations indicate that steam slip is dependent upon channel geometry, inlet water velocity, and rate of heat addition. A simplified momentum model is postulated which leads to equal friction and head losses of two phases. The model gives good agreement with available experimental results in horizontal and vertical test sections with and without heat addition at pressures from 12 to 2000 psia. Discussion of the model in terms of nonquasi steady-state unbalances of friction and head losses of the two phases explains experimental deviations from the predictions and the previously noted effects of water inlet velocity. It also gives trends for the effects of channel geometry and rate of heat addition. Application of the simplified model to calculating two-phase pressure drops is included. (auth)

15749

PRESSURE DROP AND HEAT TRANSFER IN A DUCT WITH TRIANGULAR CROSS SECTION. E. R. G. Eckert and T. F. Irvine, Jr. (Univ. of Minnesota, Minneapolis). J. Heat Transfer 82, 125-38(1960) May.

Friction factors were measured for a duct whose cross section has the shape of an isosceles triangle with a side ratio 5 to 1 in the fully developed flow region for laminar, transitional, and turbulent conditions. In addition, local and average heat-transfer coefficients and the temperature field in the duct wall have been determined for the condition of constant heat generation per unit volume of the duct walls. Friction factors in laminar flow agreed well with analytical predictions. In the turbulent flow range they were by 20 per cent lower than values calculated from relations for a round tube with the use of the "hydraulic diameter." Heat-transfer coefficients averaged over the circumference of the duct were only half as large as values calculated from round tube relations in the Reynolds number range from 4300 to 24,000. The measurements also revealed that thermal starting lengths were in excess of 100 diameters. In round tubes a length of 10 to 20 diame-

ters has been found sufficient to develop the temperature field. (auth)

15750

EXPERIMENTAL INVESTIGATIONS OF PRESSURE DROP THROUGH INTERRUPTED-PLATE-TYPE FUEL ELEMENTS. B. W. LeTourneau and R. E. Grimble (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 7, 458-67(1960) May.

One possible nuclear reactor fuel element design consists of plate-type subassemblies cut transversely into a number of sections in the direction of flow. The use of such interrupted-plate elements should result in lower surface temperatures than full-length plate-type subassemblies by taking advantage of both a continuous entrance effect on the film coefficient of heat transfer and reduced engineering hot channel factors. The purpose of this paper is to report the results of experimental investigations of the pressure drop through such interrupted-plate-type fuel elements. In particular, the joint losses between adjacent sections of a plate-type subassembly, and the entrance-plus-exit losses on entering the initial section and leaving the final section of subassembly, have been measured as a function of Reynolds Number and, in the case of the joint losses, as a function of the spacing between the sections. Measurements have been made on six configurations; one subassembly with the plates in adjacent sections of the subassembly parallel and one with them perpendicular to each other (in-line and crossed), each subassembly being tested for the square-edged, rounded leading edge, and both ends rounded cases. Most of the measurements were made on 2 in. long sections of 2.1-in. sq subassembly containing ten 0.087 × 1.82 in. plates and eleven 0.087 × 1.82 in. channels. The effect of longer sections was also investigated. Experimental values of dimensionless joint loss and entrance-plus-exit loss coefficients were calculated from experimental over-all pressure drops using values for the friction factor from the literature. These experimental loss coefficients are presented graphically as a function of Reynolds Number for each configuration tested. All of the loss coefficients showed slight decreases with increasing Reynolds Number in the range tested (Reynolds Numbers from 10,000 to 100,000). Values of the joint loss coefficients are also presented graphically as a function of spacing between the sections for each configuration at a Reynolds Number of 50,000. This graph shows that the joint loss coefficients are higher than the entrance-plus-exit loss coefficients if the adjacent plate sections are square-edged and crossed, approximately the same if the adjacent sections are crossed but have rounded ends, and lower if the adjacent sections are in-line. The joint loss coefficients approach the experimental entrance-plus-exit coefficients (which agreed well with values in the literature) at large spacings, and the two were essentially equal when the spacing reached 0.05 to 0.50 in. depending on the configuration. (auth)

15751

THE INTERACTION OF HIGH TEMPERATURE AIR WITH MATERIALS DURING RE-ENTRY. Mac C. Adams (Avco-Everett Research Lab., Everett, Mass.) and E. Scala (Avco Research and Advanced Development Div., Wilmington, Mass.). p.54-60 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

An outline of progress in solution of problems related to heat transfer in re-entry materials is presented. Included are discussions on subjects in the areas of ablation material requirements, laboratory experiments for selection and evaluation of such materials, brittle fracture and thermal stress, materials development, and fabrication. (J.R.D.)

15752

MATERIALS AND TECHNIQUES FOR THERMAL TRANSFER AND ACCOMMODATION. Harry A. King (Aerojet-General Corp., Azusa, Calif.). p.129-44 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A discussion is presented of some general advantages and disadvantages of the various techniques currently used to overcome the deleterious effects encountered by missile nose cones during re-entry and in other areas where such heat transfer rates are encountered. Materials whose properties make them of interest in thermal transfer and accommodation are also examined. (J.R.D.)

Instrumentation

15753 AERE-R-3289

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DETECTION OF GAMMA RADIATION BY INDUCED CONDUCTIVITY. C. G. Clayton. Mar. 1960. 25p. BIS.

For the detection of beta and gamma radiation, the measurement of induced photoconductivity in insulators and semiconductors can be used. Some of the characteristics of photoconductors which become important when employing them as radiation detectors are considered. (W.D.M.)

15754 AERE-R-3292

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A GENERAL PURPOSE TWO CHANNEL COINCIDENCE UNIT A.E.R.E. TYPE NO. 2013A. F. H. Wells, G. L. Godfrey, and A. K. Barlow. Mar. 1960. 18p. BIS.

A two-channel coincidence or anti-coincidence unit for use in the range 0.1 to 5 μsec is described. The input circuits contain a paralysis network to prevent overloading of the circuit with a dead time of approximately 5 μsec. The unit uses semiconductor devices as active circuit elements, and the majority of the circuit components are mounted on four standard plug-in printed circuit boards. (W.D.M.)

15755 CF-60-5-72

Oak Ridge National Lab., Tenn.

IBM-704 CODES FOR PREDICTING THE RESPONSE OF GAMMA-RAY SCINTILLATION COUNTERS. C. D. Zerby and H. S. Moran. May 19, 1960. 27p. OTS.

A manual for operating several codes for an IBM-704 to calculate the pulse-height response functions for gamma-ray scintillation counters is presented. Using the Monte Carlo method of computation, the codes will calculate the pulse-height response function of xylene, CsI, or NaI counters of various geometrical configurations with cylindrical symmetry. Various monoenergetic source configurations are possible with a maximum source energy of 10.22 Mev. (auth)

15756 CF-60-5-104

Oak Ridge National Lab., Tenn.

HIGH CURRENT SATURATION CHARACTERISTICS OF

THE ORNL COMPENSATED IONIZATION CHAMBER (Q-1045). J. L. Kaufman. May 25, 1960. 4p. Contract [W-7405-eng-26]. OTS.

The saturation voltage and current characteristics of a compensated ionization chamber (Q-1045) were measured with special regard to high current and voltage ranges. The chamber can be operated at currents up to 1 ma with a 2000 volt power supply. (auth)

15757 CF-60-5-121

Oak Ridge National Lab., Tenn.

USE OF SILICON SURFACE-BARRIER COUNTERS IN FAST-NEUTRON DETECTION AND SPECTROSCOPY. T. A. Love and R. B. Murray. May 31, 1960. 25p. OTS.

A neutron-sensitive semiconductor counter was constructed by depositing a thin layer of Li^6F between two silicon surface-barrier counters. Neutrons are detected by observing the α + T pair resulting from the $Li^6(n,\alpha)T$ reaction; pulses from the two counters are added, and the sum pulse is amplified and recorded on a multichannel analyzer. Since the sandwich geometry permits simultaneous detection of both reaction products, the magnitude of the resulting sum pulse is proportional to the energy of the incoming neutron. Pulse-height spectra from slow neutrons and monoenergetic fast neutrons, in the energy region 0.6 to 3.5 Mev, were recorded from two counters of this type; in both counters the sensitive area was about 0.7 cm^2, with a Li^6F layer of order 150 $\mu g/cm^2$ thick. In all cases, a well defined neutron peak was observed in the pulse-height spectrum. In a typical case the full width at half maximum of the fast-neutron peak was about 300 kev. Counters of this type are relatively insensitive to background effects, notably gamma rays, and thus may prove to be useful in the detection and spectroscopy of fast neutrons. (auth)

15758 DP-356

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

AN AUTOMATIC GAS CHROMATOGRAPH FOR MONITORING OF REACTOR FUEL FAILURES. PART I. DESIGN. William R. Kritz. Apr. 1959. 10p. Contract AT(07-2)-1. OTS.

A device was developed for detecting the failure of a fuel element in a reactor by monitoring for the presence of gaseous fission products. Small amounts of gaseous fission products were detected in the presence of radioactive argon by separating the fission product gases from the argon by chromatography. An automatic sequencing device was provided for taking samples at short intervals to ensure rapid detection of failures. (auth)

15759 DP-441

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A VERSATILE RECORDING POTENTIOMETER. C. O. Ballou. Feb. 1960. 19p. Contract AT(07-2)-1. OTS.

A recording potentiometer was modified to provide a versatile instrument that can be applied to a variety of problems without time-consuming changes. Ranges may be selected in six spans, from 0.5 to 100 mv. No adjustments of amplifier gain are required when switching from one range to another. Zero suppression is continuously variable over a ±100 mv range by means of coarse and vernier controls. Cold junction compensation is provided for four standard thermocouples, and chart speeds from ½ to 16 in./hr may be selected at will. (auth)

15760 DP-461

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

A COLORIMETER FOR IN-LINE ANALYSIS OF URANIUM AND PLUTONIUM SOLUTIONS. Donald W. Colvin. Mar. 1960. 23p. Contract AT(07-2)-1. OTS.

A colorimeter is described that can be used to monitor process solutions continuously for uranyl nitrate or plutonium nitrate concentration. The instrument was tested under plant conditions in the concentration range from 0.1 to 70 grams of uranium per liter and 0.1 to 10 grams of plutonium per liter. The instrument error was ±1% of the span, but errors of 15 to 20% can be caused by other variables such as acidity and other salts present. (auth)

15761 GAT-T-786

Goodyear Atomic Corp., Portsmouth, Ohio.

PRESSURE TRANSMITTER. J. E. Walker. May 25, 1960. 4p. Contract AT(33-2)-1. OTS.

The nozzle and booster pilot assembly of a Moore 40-15 transmitter was used as the basic component to develop a pressure transmitter intended as an alternative device to the Booth-Cromer gage. The particular advantage of the Booth-Cromer gage, that of low holdup volume, would be retained and some of the disadvantages would be eliminated. The use of Monel or nickel parts with Monel, nickel, or phosphor bronze diaphragms between the measuring pressure chamber and adjacent chambers permits pressure measurements of corrosive gases. Only air is required for chamber pressures other than the measuring pressure chamber. (auth)

15762 HW-44842

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

GAMMASCAN OPERATING DETAILS AND SERVICING INSTRUCTIONS. [1956]. Decl. May 4, 1960. 16p. Contract [W-31-109-Eng-52]. OTS.

The operation and performance of the Gammascan system, a system for individual reactor fuel tube rupture detection and identification on a specific crossheader, are discussed. Diagrams of the Gammascan chassis details and assembly, installation, and circuitry are presented. (C.J.G.)

15763 K-935

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

A NEEDLE-VALVE TYPE OF VARIABLE LEAK FOR URANIUM HEXAFLUORIDE MASS SPECTROMETERS. E. F. Babelay and L. A. Smith. Sept. 18, 1952. Decl. Mar. 7, 1960. 17p. Contract W-7405-eng-26. OTS.

A mass spectrometer sample inlet leak was developed from a standard needle valve. The valve is equipped with a wedge and lever system which permits control of the needle position within one ten-thousandth of an inch. The leak proved particularly suitable for use in the isotopic analysis of uranium hexafluoride. (auth)

15764 NP-8683

Canada. Ontario Research Foundation.

BETA-RAY GAUGES FOR GAS DENSITY MEASUREMENTS. Physics Research Report No. 6001. B. W. Schumacher. Jan. 18, 1960. 25p. 1 illus.

Data are presented for beta gages or other electron probes working on the attenuation principle for measuring gas densities. A range (ρs) of density per unit area from below 10^{-5} to over 1 g/cm^2 can be covered by a proper selection of the attenuation coefficient α [cm^2/g] i.e., of the electron energy. It is shown that for every α a range of (ρs) of about 10:1 exists for which the accuracy of the gauge is high and nearly constant, and in fact, much better than the counting statistics may suggest. The accuracy (coefficient of variation)$\sigma(\rho s)$ / $\overline{\rho s}$ shows a flat optimum at the point where the beam intensity has fallen to J_0/e^2, i.e.,

when $\alpha\rho s = 2$. The relations are shown in graphs from which numerical values for any particular case are readily obtainable. Ranges and attenuation coefficients for beta-sources are shown. (auth)

15765 NP-8716

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

STUDY OF MASS FLOWMETERS. Final Report [for] period covered June 26, 1958 to June 15, 1959. C. C. Miesse. July 15, 1959. 132p. Project No. D173. Contract DA-11-022-ORD-2857.

A survey was conducted of mass flowmeters such as volumetric meters with automatic temperature-dependent density compensation, transverse momentum-type flowmeters, and other types of flowmeters which can be adapted to the measurement of mass flow. It was concluded that volumetric meters with density compensation are inadequate for non-uniform mass flow while transverse momentum-type flowmeters are well suited for such measurements. The more exotic devices require further development. The types of flowmeters considered sufficiently accurate to warrant further investigation are listed, and a detailed report of the calibration techniques used for these is included. (J.R.D.)

15766 NP-8756

Scripps Institution of Oceanography, La Jolla, Calif.

ACCESSORY TO MULTICHANNEL GAMMA-RAY SPECTROGRAPH FOR RAPIDLY TRANSFERRING STORED SPECTRA TO STORAGE TAPE LOOPS AND FOR RAPIDLY DISSECTING THE SPECTRA INTO COMPONENTS. T. R. Folsom and R. A. Cramer. Sept. 10, 1958. 35p.

The Argonne 256-channel pulse analyzer is described with block diagrams. A method for rapidly transferring stored spectra to storage tape loops and for rapidly dissecting or subtracting the spectra is discussed. The electrical equipment required for reading the information out of the magnetic matrix memory onto the loop of magnetic tape or subtracting any fraction of stored material from information in the matrix is described and block diagrams are given. (C.J.G.)

15767 NYO-9026

Rochester, N. Y. Univ.

A MULTI-CHANNEL UNIT OF SOLID STATE COUNTERS FOR NUCLEAR SPECTROSCOPY. O. M. Bilaniuk, A. K. Hamann, and B. B. Marsh. May 20, 1960. 24p. Contract AT(30-1)-875. OTS.

A matrix of twenty 2×12 mm^2 surface barrier counters was constructed for use in the image plane of a magnetic spectrometer. The outputs of individual crystals are displayed in predetermined channels of a 100-channel pulse-height analyzer. This is done by connecting separate crystals to successive sections of a delay line and converting the time difference between signals arriving at the ends of the line into pulse heights. Simple procedures for producing reliable Ge-Au surface barriers and contacts and certain properties of such counters are discussed. A sample of information decoded by this unit is presented. (auth)

15768 SCTM-107-55(53)

Sandia Corp., Albuquerque, N. Mex.

THE PRINTED WIRING TECHNIQUE APPLIED TO UNIT PACKAGING OF A PLUG-IN FM OSCILLATOR AND DC AMPLIFIER. R. P. Noble. May 23, 1955. 16p. OTS.

The design technique employed in the electronic packaging of the Model 306 record channel and DC amplifier is described. The advantages of this technique are pointed out and a comparison is made between conventional packaging techniques and the printed wiring technique. (auth)

15769 SCTM-234-54(52)

Sandia Corp., Albuquerque, N. Mex.

A WIND VELOCITY GAGE MODEL II. H. G. Laursen. Oct. 19, 1954. 10p. OTS.

Design details and drawings are given for a wind velocity gage to measure wind velocities from 30 to greater than 700 miles per hour. The instrument is battery operated and designed to withstand severe shocks. Circuit details are included. (C.H.)

15770 SCTM-359-58(81)

Sandia Corp., Albuquerque, N. Mex.

CONSTANT CURRENT BATTERY DISCHARGER. R. J. Tockey. May 27, 1959. 14p. Contract AT(29-[1])-789. OTS.

A constant current battery discharger which will measure and indicate the useful charge content of batteries discharged under constant current conditions is described. The device makes possible testing of several batteries simultaneously by a single operator. (auth)

15771 SGAE-59/1 B

Österreichische Studiengesellschaft für Atomenergie GmbH., Vienna.

EINRICHTUNG ZUR MESSUNG DER WINKELKORRELATION RADIOAKTIVER STRAHLUNGEN. (Equipment for Measurement of Angular Correlation of Radioactive Rays). Peter Weinzierl, Wolfgang Schneider, and Walter Bartl. [1959]. 32p.

A description is given of the apparatus used for angular correlation measurements. The apparatus includes surveyor's table and preamplifier, pulse time circuit amplifier, and fast coincidence equipment. Some test results are given. (T.R.H.)

15772 TID-3550

Technical Information Service Extension, AEC.

NUCLEAR INSTRUMENTATION. A Literature Search. Henry D. Raleigh and Raymond L. Scott, comps. Apr. 1960. 112p. OTS.

Included are 1,219 references from reports and journals on the design, construction, and application of instruments for radiation environments. Reactor instrumentation and radiation detection instruments comprise the major portion of the references. (W.D.M.)

15773 TID-5890

Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.

UNITIZED SYSTEM OF IMAGE INTENSIFIERS USING FIBER OPTICS. Progress Report [for] November 1959 through March 1960. J. S. Kalafut. 19p. Contract AT(30-1)-2176. OTS.

Improvement in the technology of sealing fiber optic faceplates to various types and sizes of vacuum envelopes is reported. Good mechanical seals using both 1 and 5 inch fiber optic faceplates are reported. Details of other experiments are given, and indications of the direction in which further work is now proceeding are summarized. (For preceding period see AECU 4622.) (J.R.D.)

15774 TID-5950

Evans Research and Development Corp., New York.

[RESEARCH ON THE DEVELOPMENT OF A BETA-RAY PARTICLE SIZE ANALYZER (BPSA)]. Monthly Progress Letter for April 16—May 14, 1960. Eric J. Hewitt. May 25, 1960. 5p. Contract AT(30-1)-2372. OTS.

Continuing tests for leakage of activity from the C^{14}

sources revealed that Mylar can be employed as a covering only for short-period experiments (up to 3 days). Diagrams are presented of the beta particle size analyzer with the new sources in place. (See also AECU-4566.) (C.J.G.)

15775 UCRL-5377

California. Univ., Livermore. Radiation Lab.
THE FREE-FREE ABSORPTION COEFFICIENT IN IONIZED GASES. Hugh De Witt. Oct. 1958. 27p. Contract W-7405-eng-48. OTS.

The free-free absorption coefficient of radiation passing through a fully ionized gas has been calculated for the Debye potential in order to determine the effects of electron screening. Complete analytical results for all frequency ranges are obtained when the Born approximation bremsstrahlung cross section for the Debye potential is used. For high frequency radiation, $\hbar\omega > kT$, an approximate formula for the absorption coefficient was derived using the Born-Elwert approximation to the bremsstrahlung cross section; this approximate expression reproduces exact numerical calculations to within a few percent. A classical bremsstrahlung cross section for the Debye potential was used in the calculation of the absorption coefficient for low-frequency radiation in order to take into account the classical behavior of the slower moving electrons of the Maxwellian velocity distribution. An expression is obtained which takes into account screening and makes a smooth transition from the Born result valid for high temperatures to a classical expression for low temperatures. A simple analytical function is derived which corrects the absorption coefficient for the pure Coulomb field for screening. For frequencies greater than the electron plasma frequency the correction is of the order $(\omega/\omega_p)^2$, and for low frequencies the logarithmic divergence of the pure Coulomb potential is cut off. (auth)

15776 UCRL-5808

California. Univ., Livermore. Lawrence Radiation Lab.
SCINTILLATION COUNTER γ-SPECTRA UNFOLDING CODE FOR THE IBM-650 COMPUTER. Harry I. West, Jr. and Bradley Johnston. Feb. 17, 1960. 26p. Contract W-7405-eng-48. OTS.

An IBM-650 code for the detailed unfolding of gamma spectra obtained from NaI scintillation counters was developed. The procedure is set up to remove analyzer scale dependence and to largely remove energy dependences. Computer time is about one minute per γ ray. (auth)

15777 USNRDL-TR-408

Naval Radiological Defense Lab., San Francisco.
THE MODIFICATION AND CALIBRATION OF LANDSVERK MODEL L-62 CHARGER-READERS FOR INTERCHANGEABILITY. R. L. Lynn. Mar. 28, 1960. 22p.

Landsverk Model L-62 charger-readers and their calibration procedure were modified so that Landsverk pocket chambers can be charged on any of the charger-readers and subsequently read on any other of the charger-readers without introducing significant error in the dose reading. The modifications were primarily concerned with the establishment of an equal, constant value, charging voltage for all the pocket chambers. The introduction of an offset zero position for reading Landsverk Model L-65, 200-mr pocket chambers, to compensate for the negative readings of fully charged 200-mr pocket chambers was also accomplished. With the modified L-62 charger-readers, a constant value of applied voltage on a pocket chamber will yield dose readings reproducible to better than 5% for consecutive readings made on different charger-readers. This value is compared with a discrepancy of about 15% for similar readings on unmodified L-62 charger-readers. A precision of 1% can be realized for consecutive readings made on any one modified charger-reader. (auth)

15778 WADC-TR-59-653

Dayton, Ohio. Univ. Research Inst.
THE ACQUISITION OF DATA GATHERED IN THE VICINITY OF HIGH-ALTITUDE NUCLEAR DETONATIONS: RECORDING, TELEMETRY, AND RECOVERY AT SEA. Roger H. Keith. Nov. 1959. 85p. Project No. 1350. Contract AF33(616)-5427. (AD-231977).

A survey was made of data acquisition methods for use in the vicinity of high-altitude nuclear detonations. Information was obtained through searches of the literature and manufacturers' data, visits to authoritative groups, and independent research and development. Recording, telemetry, and information recovery systems were examined. The past uses of data acquisition methods and recent improvements are described. New systems are suggested and principles of system selection and design are discussed. Applications of various systems in returning data gathered at high altitudes are considered. (C.H.)

15779

ALL-TEFLON COUNTING CELL FOR FLOWING RADIOACTIVE SOLUTIONS. W. J. Blaedel and Eugene D. Olsen (Univ. of Wisconsin, Madison). Anal. Chem. 32, 789-91 (1960) June.

An all-Teflon counting cell was constructed for continuous monitoring of small radioactive effluent streams. The bonding procedure permits a very thin film of Teflon to be firmly fastened to a Teflon cell block, and enables solution counting of even as weak a beta-emitter as calcium-45. Entrapment of air, holdup, and mixing are minimized. A few elements are adsorbed very strongly by Teflon and the last traces are not removed even by extended washing. (auth)

15780

MODIFICATION OF THE FORRO RADIOCHROMATOGRAM SCANNER FOR CONTINUOUS SCANNING. J. A. Demetriou (Univ. of Southern California, Los Angeles) and P. Polamero (Beam Products Mfg. Co., Glendale, Calif.). Anal. Chem. 32, 895-6(1960) June.

The operation of the Forro chromatogram scanner, as available from the manufacturer, is limited to the hours of a normal working day. Modifications were made to the instrument which have permitted continuous unattended operation for periods of up to 5 days. The modifications are described. (W.L.H.)

15781

PRECISION PHASE CONTRAST REFRACTOMETRY AND ITS APPLICATION TO HEAVY-LIGHT WATER. Erik Djurle (Royal Inst. of Tech., Stockholm). Arkiv Fysik 17, 1-59(1960). (In English)

The imaging of objects in the phase contrast refractometer has been treated by means of diffraction theory and the results obtained have been used in the design and construction of a new refractometer. The properties of the instrument have been examined from different aspects, e.g., the sensitivity, the demands on mechanical stability, temperature constancy etc. The measuring range is determined by the spectral properties of the lamp and monochromator and this unit has been thoroughly examined by determining the contrast at many interference periods in the instrument and also by means of a birefringent interferometer. The lower limit is set, by the photometric accuracy, to 3×10^{-6} in refractive index difference and the upper, by the monochromaticity of the spectral line, to 9×10^{-3} with a cell 30

mm long. Various experiences obtained during measurements on gases are reported. For liquids, the system heavy-light water has been thoroughly examined. The treatment of the water to give reproducible results is discussed. The refractive index difference for heavy water and ordinary water, $\Delta n = n_{D_2O} - n_{H_2O}$, has been measured at two temperatures. From these measurements, the following equations valid at 20.0°C have been obtained: $-\Delta n \times 10^7 = 48662x - 143x^2$ for $\lambda = 5461$ A and $-\Delta n \times 10^7 = 52960x - 174x^2$ for $\lambda = 4358$ A (x is the excess concentration of deuterium in the sample relative to the content in ordinary water). These equations have been compared with equations which were theoretically calculated using the Dale-Gladstone formula and the volumes of the solution and its components. The agreement shows that the refractive index of the solution is correctly described by this law. For the temperature derivative, the following values have been obtained: $d(\Delta n)/dt = +25.0x \times 10^{-6}$ for $\lambda = 5461$ A and $d(\Delta n)/dt = +26.0x \times 10^{-6}$ for $\lambda = 4358$ A. The determination of heavy water concentrations using the phase contrast refractometer gives an accuracy of 0.002 mole per cent in the low concentration region where the limit is set by the reproducibility of the treatment of the water. This corresponds to 15×10^{-8} in refractive index. For higher concentrations, the accuracy diminishes due to the errors in the equations given above and, in the highest region, it is 0.02 mole per cent. The influence of pressure on the refractive index was also examined for ordinary water and heavy water. The values obtained for the isothermal compressibility are for ordinary water 44.9×10^{-11} m²/N and for heavy water 45.9×10^{-11} m²/N. These values are compared with others determined by means of other methods and it is seen that the agreement is good. In this work, Dale-Gladstone's law was also used and was found to give a good description of the phenomena. (auth)

15782

METROLOGY APPLIED TO RADIOACTIVITY IN THE USSR. K. K. Aglintsev, V. V. Bochkarev, V. N. Grablevskii, and F. M. Karavaev. Atomnaya Energ. 8, 354-9(1960) Apr. (In Russian)

A review is presented on the standardization of radioactive sources and methods for measuring radioactivity. General principles of radiometric measurements based on the application of uniform unit systems, calibrating methods and installations, and methods of relative measurement by means of standard sources are discussed. Descriptions are given of the principal characteristics of standard radioactive sources. (tr-auth)

15783

FIELD HOMOGENIZING IRON PLATES FOR NUCLEAR SPIN RESONANCE SPECTROMETER. K. Antonowicz (Nicholas Copernicus Univ., Toruń, Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 115-16 (1960). (In English)

Methods used in improving the homogeneity of the magnetic fields in nuclear resonance spectrographs are presented. A modification of that described by Purcell is described. The effect of Purcell's method is that of a magnetic filter, by pole caps laminated transversally to the field direction. The proposed method consists of two symmetrically disposed soft iron plates parallel to the single-piece pole surfaces. The effectiveness of this filter was proven by observation of the splitting of the methyl alcohol line. The alcohol triplet was obtained in the 10^{-6} field without the filter, and lines of CH_3 and CH_2 groups were split into a triplet and a quadruplet in the 10^{-7} filtered field. (B.O.G.)

15784

THE AQUEOUS BENZOATE SYSTEM AS A SENSITIVE DOSIMETER FOR IONIZING RADIATIONS. W. A. Armstrong and D. W. Grant (Defence Research Chemical Labs., Ottawa). Can. J. Chem. 38, 845-50(1960) June.

The aqueous benzoate system, as typified by 6×10^{-4} M calcium benzoate, meets many of the requirements for a sensitive chemical dosimeter. The concentration of salicylic acid, determined spectrophotofluorometrically, increases linearly with radiation dose in the range 5 to 5000 rads and is independent of temperature from 15 to 45°C, of energy from 160 kev to 3 Mev, and of dose rate from 4 to about 1000 rads/minute. The decrease in sensitivity with increasing dose rate from 1000 to 85,000 rads/minute is reported. (auth)

15785

SEPARATION OF MINERALS IN A STREAM OF IONS PRODUCED BY α-RADIATION. I. N. Plaksin and L. P. Starchik (Mining Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 85-6(1960) Mar. 1. (In Russian)

Descriptions are given of an electrostatic separator using α particle ionization for charging mineral particles. The intense α ionization can be utilized in other installations using crown discharge for charging mineral particles, as for instance in crown chamber separators. (R.V.J.)

15786

RESULTS OF THE INVESTIGATION OF UNSETTLED CURRENTS IN ION COUNTERS. N. N. Komar (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 3, 459-66(1960) Mar. (In Russian)

Experimental studies were made of the unsettled currents in counter condensers. Experimental and theoretical data are correlated, and the practical efficiency of the counters is evaluated. (tr-auth)

15787

A UNIVERSAL PHOTORECORDING SYSTEM FOR RADIOISOTOPE AREA SCANNERS. Carl E. Herring (Western Reserve University School of Medicine, Cleveland). J. Nuclear Med. 1, 83-101(1960) Apr.

Criteria for data recording systems suitable for radioisotope scanning are reviewed. Design developments are discussed. A specific photorecording system is described and illustrated which satisfies the criteria set forth. (C.H.)

15788

RESEARCH ON BF_3 PROPORTIONAL COUNTERS. H. F. Brinckmann and D. Gerber (Zentralinstitut für Kernphysik, Rossendorf, Ger. and VEB Vakutronik, Dresden). Kernenergie 3, 309-14(1960) Apr. (In German)

Results are given from research on BF_3 proportional counters conducted in the course of industrial development. From measurements of the pulse-height distribution for the reaction $B^{10}(n,\alpha)Li^7$, the probability for the process in the ground state of Li^7 was found to be $6.51 \pm 0.5\%$. The effects of γ rays on the counting-tube plateau and the maximum permissible γ dose as a function filling pressure are given. Measurement errors due to radiation from Al and Cu counting tubes, which are activated to saturation in a flux of 5×10^6 neutrons/cm²/sec, can be kept at a negligible minimum by suitably low working potentials. For storage periods up to 20 months after BF_3 filling, the copper counting tube shows no change in characteristics. The plateau disturbances dependent on BF_3 pressure are clearly evident after 18 months storage for glass counting tubes with graphite cathodes. The lifetime L is dependent on the gas amplification M, and can be described by the relation

$L \geq 5 \times 10^{12}/M$. A method for determining the gas amplification is given. (tr-auth)

15789

A NEUTRON DETECTOR WITH CONSTANT SENSITIVITY FOR NEUTRONS OF ENERGY 0.025 TO 14 Mev. P. I. Vacet, S. G. Tonapetyan (Tonapetjan), and G. A. Dorofeev. Kernenergie 3, 399-401(1960) Apr. (In German)

A neutron detector consisting of a boron counting tube which is movable in a paraffin block is described, and studies made with it are reported. The 30-mm diam counting tube was filled with BF_3 (70% B^{10}, pressure 140 torr) and at a 1700v operating potential had a plateau length of 300v. The tube was placed at different positions in the block and its sensitivity measured. Position of optimum sensitivity was found where the deviation was ±3% between 0.025 Mev and 5 Mev, and 11% at 14 Mev. (T.R.H.)

15790

A SCINTILLATION GAMMA-ENCEPHALOMETER FOR THE DIAGNOSIS OF CEREBRAL TUMORS. K. N. Badmaev, S. G. Zenkovich, and I. A. Sokolov (Polenov Leningrad Scientific-Research Inst. of Neurosurgery, USSR). Med. Radiol. 5, No. 4, 57-64(1960) Apr. (In Russian)

A description of two scintillation gamma-encephalometers (unicanal and bicanal with a scanner) for the diagnosis of cerebral tumors is given. The principal schemes of both devices, their advantages, and shortcomings are discussed. (auth)

15791

A ROENTGENOMETER FOR MEASURING CURATIVE DOSES. R. V. Stavitskiĭ (Central Inst. of Graduate Studies in Medicine, USSR). Med. Radiol 5, No. 4, 65-7(1960) Apr. (In Russian)

The principle of a roentgenometer which incorporates the design of a small portable dosimeter for measuring curative doses is discussed. (C.J.G.)

15792

RADIOMETRIC MEASUREMENTS UNDER CONDITIONS OF A STRONGLY VARIABLE BACKGROUND. B. A. Glazun (Voronezh District Sanitary-Epidemiological Station, USSR). Med. Radiol. 5, No. 4, 72-6(1960) Apr. (In Russian)

The major importance of correct estimation of the background value of samples under radiometric analysis at the moment of sample activity measurement is discussed. It is pointed out that measurements following the common scheme (measurements of the background value, of the sample activity and of the background) may run into very substantial errors. Observations prove that correct results can be obtained by adhering to the scheme of measurements of sample activity and background values effected simultaneously with one counter, with parallel background measurement made by another one. In the case of a stable background, the error margin of the background estimation, made at the time of the sample activity measurement, should be equal to that encountered in measurements effected according to the common scheme. (auth)

15793

'PRIZE': A PRE-IONIZED 'THETA' PINCH. R. D. Medford, A. L. T. Powell, J. D. Herbert, R. C. Pottinger, and J. K. Wright (Atomic Weapons Research Establishment, Foulness, Essex, Eng.). Nature 186, 706-7(1960) May 28.

Design characteristics are described of an electromagnetic shock tube using preionization in the Z direction followed by a theta pinch. Its main function is to form a high-temperature plasma in deuterium gas by shock heating without the ubiquitous trapped magnetic field usually associated with theta pinches. A schematic sketch of the circuitry and experimental results is included. (C.H.)

15794

A RECORDING DOSIMETER FILM INDEPENDENT OF WAVE LENGTH. K. Becker, E. Klein, and E. Zeitler (Agfa A. G., Leverkusen, Ger.). Naturwissenschaften 47, 199-200(1960). (In German)

The incorporation of an organic phosphor directly into the photographic emulsion makes the construction of the dosimetric film plates simple and improves the fluorescence yield. The utilization of p-terphenyl, whose maximum fluorescence emission is in the range of maximum photographic sensitivity, was studied. It was shown that by the selection of a suitable ratio of the silver halogenide to the phosphor, wave length independence can be obtained. The ratio is chiefly a function of the hardness factor of the layer and the relationship of the x and gamma sensitivity to the light sensitivity. The properties of emulsions with p-terphenyl are given. (J.S.R.)

15795

γ-γ COINCIDENCE METHOD FOR MEASURING RESONANCE ESCAPE PROBABILITY IN U^{238} LATTICES. Rudolph Sher (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 7, 479-80(1960) May.

A technique is described which does not require chemical work but which eliminates the extraneous activities near 100 kev. The method consists simply of counting coincidences between two of the γ rays in the Np^{239} decay, those at 285 and 106 kev. A high degree of sophistication in the coincidence circuits is not required, at least for measurements of relative disintegration rates. (W.L.H.)

15796

A NEW METHOD FOR TIMING SCINTILLATION PULSES. F. T. Arecchi, E. Gatti, and E. Zaglio (Centro Informazioni Studi Esperienze, Milan). Nuovo cimento (10) 16, 198-201 (1960) Apr. 1. (In English)

A method is proposed for the accurate detection of the zero crossing of high-frequency light pulses in a photomultiplier (PM). In this method, the anode and last dynode of the PM excite two damped resonant circuits with frequencies differing by a factor of two; their voltage outputs drive the deflection plates of a C. R. T. causing a Lissajous figure, a small part of which is observed through a slit. Different pulses are observed for equal periods of time, thus giving standard illumination pulses which in turn give standard current pulses in another PM looking at the slit. The time position of these pulses is detected by a Moody discriminator. This apparatus was used to determine the coincidence curve for γ radiation from Na^{22}. (D.L.C.)

15797

A 10 IN. DIAMETER LIQUID HYDROGEN BUBBLE CHAMBER. Margaret H. Alston, D. C. Cundy, W. H. Evans, R. W. Newport, and P. R. Williams (Univ. of Liverpool). Phil. Mag. (8), 5, 146-53(1960) Feb.

The important design features of a 10-in. hydrogen bubble chamber, its magnet, and the associated control circuitry are presented, e.g., the means of illumination, expansion system, safety precautions, and operational procedures. (auth)

15798

SYSTEMATIC TRACK DISTORTION IN A 10 IN. DIAMETER LIQUID HYDROGEN BUBBLE CHAMBER. D. C. Cundy, W. H. Evans, D. W. Hadley, P. Mason, R. W. Newport, J. R. Smith, and P. R. Williams (Univ. of Liverpool). Phil. Mag. (8), 5, 154-60(1960) Feb.

An investigation was made on the dependence of systematic track distortion in a 10-in. diameter liquid hydrogen

bubble chamber upon track position in the chamber, beam entry time, and flash delay. It is seen that provided photography occurs before recompression the distortions are small compared with the multiple scattering curvature and are not significantly different from zero except at the extreme top and bottom of the chamber. (auth)

15799

THIN-FILM THERMOMETER MEASUREMENTS IN PARTIALLY IONIZED SHOCK-TUBE FLOWS. P. V. Marrone and R. A. Hartunian (Cornell Aeronautical Lab., Inc., Buffalo). Phys. Fluids 2, 719-21(1959) Nov.-Dec.

A technique was developed for dealing with the production of spurious electrical signals by partially ionized shock-tube flows in the output of platinum-film resistance thermometers. It involves coating the platinum element with SiO by evaporation and converting this coat to SiO_2 by firing. Voltages achieved across this SiO_2 film (800 to 1000 A thick) indicate breakdown potentials of ~1000 kv/cm. Thermometers with and without such films were tested in argon at shock Mach numbers up to 14; the surface temperature rise of the shock tube sidewall was measured after passage of the shock wave. The thermometers with films exhibited excellent agreement with the theoretical curve, while the results for those without films dropped below the theoretical curve for Mach numbers above 7. Excellent results in air and oxygen were also observed for Mach numbers up to 15. No erosion of the SiO_2 films was detected. Foils of metals like gold could be applied directly over such films; this can be used for studies of surface chemistry effects on heat transfer. (D.L.C.)

15800

LOW-INDUCTANCE SWITCHING USING PARALLEL SPARK-GAPS. R. A. Fitch and N. R. McCormick (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 117-30(1959).

It is suggested that the requirements of a capacitor discharge bank for a fast low-impedance switch can be met by using many spark gaps in parallel. Three types of triggered spark-gap are described and their operation in a parallel system is analyzed. Some results of experiments on these gaps are given. Finally, a report is given of the construction and performance of the 45kJ 200-spark-gap bank currently in use at the Atomic Weapons Research Establishment. It is concluded that the system is capable of extension to much larger banks. (auth)

15801

THE IGNITRON AS A SWITCH IN HIGH-VOLTAGE HEAVY-CURRENT PULSING CIRCUITS. H. de B. Knight, L. Herbert, and R. C. Maddison (British Thomson-Houston Co., Ltd., Rugby, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 131-7(1959).

A review is given of the requirements for switches in capacitor discharge circuits, and the methods and apparatus used and the observations made in an experimental study of the operation of the ignitron for this duty are described. Photographic records show the movement of the cathode spot on the mercury cathode. At heavy currents a substantial proportion of the current is carried by cathode spots on the walls and baffles, the arc tending to follow the shortest path. (auth)

15802

TRANSFORMER DESIGN FOR TOROIDAL DISCHARGE SYSTEMS. R. Carruthers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 138-41(1959).

The transformer requirements for experiments on toroidal discharge systems are rather unusual. The basic problem, as it can be presented to the transformer designer, is described. The design of iron-cored and air-cored transformers is discussed, and it is shown that the transformer problem is not one which can be considered apart from the associated equipment. Such factors as the effect of the transformer design on energy storage requirements and torus dimensions must be taken into account. An arrangement is discussed in which the transformer is also the energy store, magnetic energy being switched between primary and secondary. (auth)

15803

SCINTILLATION COUNTING OF BETA ACTIVITY ON FILTER PAPER. B. Lionel Funt and Arlene Hetherington (Univ. of Manitoba, Winnipeg). Science 131, 1608-9(1960) May 27.

Scintillation counting of beta activity on filter paper, with monoisopropylbiphenyl as a solvent of low volatility, was investigated. The method is attractive since no sample preparation is involved, and the activities are measured directly on the filter paper wetted with the scintillator solution. A linear dependence of counting rate on total activity was found for I^{131}, P^{32}, Na^{22}, and C^{14}, and counting efficiencies were determined. (auth)

15804

A SIMPLE ATOMIC ABSORPTION SPECTROPHOTOMETER. G. F. Box and A. Walsh (Commonwealth Scientific and Industrial Research Organization, Melbourne). Spectrochim. Acta 16, 255-8(1960) Apr.

A description is given of a simple single-beam atomic absorption spectrophotometer which is adequate for many analytical requirements. (auth)

15805

THE USE OF DIFFUSED JUNCTIONS IN SILICON AS FAST-NEUTRON DOSIMETERS. O. J. Mengali and C. S. Peet (Battelle Memorial Inst., Columbus, Ohio) and E. Paskell and R. W. Beck (General Motors Corp., Kokomo, Ind.). 3p. of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17-18, 1959." New York, Cowan Publishing Corp.

Fast neutron dosimeters which are sensitive at doses where human tissue is damaged have been demonstrated. The forward current at constant voltage in modified diffused-silicon conductivity modulated junction devices was monitored and found to be a sensitive function of neutron dose. To exploit the increased lifetime with injection level, high-level injection is utilized. The contribution of surface effects to the rectifier current is reduced. The device thickness, as well as the initial bulk lifetime in base region, determined its sensitivity. Increased sensitivity was observed for wafer thicknesses where the base width approximates the diffusion length. Reductions in the forward current as large as 50% for a fast neutron dose of 600 tissue rads were found. The effect appears to be quite stable at room temperature; only slight changes from initial readings were observed a year after exposure. At higher temperatures the effects will anneal out. Results from irradiation studies on bulk silicon samples indicate a linear dependence of inverse lifetime on fast neutron dose. This was verified in the device. No permanent effect attributable to gammas was detected. (auth)

15806

THE ACCURACY AND PRECISION OF MEASURING TEMPERATURES ABOVE 1000°K. H. J. Kostkowski (National Bureau of Standards, Washington, D. C.). p.33-44 of

"Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of the current precision, accuracy, and limitations of temperature standards is presented. Instruments and techniques are discussed along with indicated improvements to be expected in the next few years. The discussion is confined to temperatures which can be maintained in the laboratory for several minutes with the emphasis on the area 1000 to 20,000°K. 46 references. (J.R.D.)

15807

APPLIED GAMMA-RAY SPECTROMETRY. C. E. Crouthamel, ed. International Series of Monographs on Analytical Chemistry, Volume 2. New York, Pergamon Press, 1960. 452p. $6.50.

This book is the outgrowth of the rapidly increasing and widespread application of gamma-ray spectrometry to many fields other than nuclear physics. Discussed are the intrinsic and extrinsic variables, which affect the observed γ-ray and x-ray spectra; calibration of detectors-scintillation counters and proportional gas counters; and specific applications-activation analysis, tracer applications, x-ray emission, and x-ray absorption. The instruments used are no longer confined to the laboratory. Appendixes are included in which are tabulated: x-ray critical absorption and emission energies; a complication of γ-ray spectra curves; intrinsic efficiencies of right cylindrical NaI crystals; and photon energies, atomic number, half-life sequences, decay modes, and active daughters of the nuclides. (B.O.G.)

15808

NUCLEAR RADIATION MEASUREMENT. J. Sharpe. Nuclear Engineering Monographs. New York, Simmons-Boardman Publishing Corporation, 1960. 76p. $2.75.

Ways in which nuclear radiations interact with matter to provide energy for the detection process and the means by which this energy is utilized are presented, since understanding of these fundamental processes is the key to successful design and operation of detectors. The basic physics of detector elements is discussed, followed by a description of technical aspects, related to the measurement of specific particles. (B.O.G.)

15809

International Atomic Energy Agency, Vienna. EQUIPEMENT ELECTRONIQUE POUR L'INDUSTRIE NUCLÉAIRE FRANÇAISE. (Electronic Equipment for the French Nuclear Industry). P. Desneiges, M. Doireau, L. Koch, and T. Weill. Review Series. Developments in the Peaceful Applications of Nuclear Energy, No. 3. 1960. 59p. $1.00.

A review is presented of the principle types of electronic apparatus used in France in nuclear laboratories, at reactors, and for prospecting, chemical control, and detection of cladding rupture. (T.R.H.)

15810

MEASURING DEVICE FOR RADIOACTIVE FLUIDS. Bengt Allan Bergstedt. British Patent 834,965. May 18, 1960.

An instrument is described for monitoring the radioactivity of fluids circulating in closed systems. A sample of the fluid is sprayed into a hot-gas jet to form a dry aerosol which is then electrostatically filtered. The filtered aerosol is then collected on a moving tape which conveys it to radiation detection and measuring instruments. The device is useful in separation processes, fluid fuel reactors, and homogeneous reactors. (T.R.H.)

15811

IMPROVEMENTS IN OR RELATING TO INDUCTION HEATING APPARATUS. Leslie William Owen (to United Kingdom Atomic Energy Authority). British Patent 835,278. May 18, 1960.

A means of controlling the heating of an induction-coil heater is given. An insulated copper-tube ring is disposed around the coil to reduce the heating at a point. The copper tube can be cooled by water. (T.R.H.)

15812

ION SOURCE. W. T. Leland (to U. S. Atomic Energy Commission). U. S. Patent 2,920,200. Jan. 5, 1960.

The ion source described essentially eliminates the problem of deposits of nonconducting materials forming on parts of the ion source by certain corrosive gases. This problem is met by removing both filament and trap from the ion chamber, spacing them apart and outside the chamber end walls, placing a focusing cylinder about the filament tip to form a thin collimated electron stream, aligning the cylinder, slits in the walls, and trap so that the electron stream does not bombard any part in the source, and heating the trap, which is bombarded by electrons, to a temperature hotter than that in the ion chamber, so that the tendency to build up a deposit caused by electron bombardment is offset by the extra heating supplied only to the trap.

15813

PARALYZER FOR PULSE HEIGHT DISTRIBUTION ANALYZER. E. Fairstein (to U. S. Atomic Energy Commission). U. S. Patent 2,922,036. Jan. 19, 1960.

A paralyzer circuit is described for use with a pulse-height distribution analyzer to prevent the analyzer from counting overlapping pulses where they would serve to provide a false indication. The paralyzer circuit comprises a pair of cathode-coupled amplifiers for amplifying pulses of opposite polarity. Diodes are provided having their anodes coupled to the separate outputs of the amplifiers to produce only positive signals, and a trigger circuit is coupled to the diodes for operation by input pulses of either polarity from the amplifiers. A delay network couples the output of the trigger circuit for delaying the pulses.

15814

HIGH CURRENT COAXIAL PHOTOMULTIPLIER TUBE N. W. Glass (to U. S. Atomic Energy Commission). U. S. Patent 2,922,048. Jan. 19, 1960.

A medium-gain photomultiplier tube having high current output, fast rise-time, and matched output impedance was developed. The photomultiplier tube comprises an elongated cylindrical envelope, a cylindrical anode supported at the axis of the envelope, a plurality of elongated spaced opaque areas on the envelope, and a plurality of light admitting windows. A photo-cathode is supported adjacent to each of the windows, and a plurality of secondary emissive dynodes are arranged in two types of radial arrays which are alternately positioned to fill the annular space between the anode and the envelope. The dynodes are in an array being radially staggered with respect to the dynodes in the adjacent array, the dynodes each having a portion arranged at an angle with respect to the electron path, such that electrons emitted by each cathode undergo multiplication upon impingement on a dynode and redirected flight to the next adjacent dynode.

15815

METHOD AND APPARATUS FOR TESTING THE PRESENCE OF SPECIFIC ATOMIC ELEMENTS IN A SUB-

STANCE. J. L. Putman (to U. S. Atomic Energy Commission). U. S. Patent 2,922,886. Jan. 26, 1960.

Detection of specific atomic elements in a substance and particularly the applicability to well logging are discussed. The principal novelty resides in the determination of several of the auxiliary energy peaks in addition to the main energy peak of the gamma-ray energy spectrum of a substance and comparison of such peaks to the spectrum of the specific atomic element being tested for, thus resulting in identification of same. The invention facilitates the identification of specific elements even when in the presence of other elements having similar gamma energy spectra as to the main energy peaks.

15816

RANDOM PULSE GENERATOR PRODUCING FIDUCIAL MARKS. W. F. Nielsen (to U. S. Atomic Energy Commission). U. S. Patent 2,923,588. Feb. 2, 1960.

The apparatus for automatically applying a fiducial marking, having a nonrepetitive pattern, to a plurality of simultaneously made records comprises, in series, a bypass filter, a trigger circuit, and a pulse generator, with printing means connected to and controlled by the pulse generator for simultaneously making the visible fiducial marks on a plurality of simultaneously produced records.

15817

CONTINUOUS GAS ANALYZER. S. Katz and C. W. Weber (to U. S. Atomic Energy Commission). U. S. Patent 2,925,327. Feb. 16, 1960.

A reagent gas and a sample gas are chemically combined on a continuous basis in a reaction zone maintained at a selected temperature. The reagent gas and the sample gas are introduced to the reaction zone at preselected, constant molar rates of flow. The reagent gas and the selected gas in the sample mixture combine in the reaction zone to form a product gas having a different number of moles from the sum of the moles of the reactants. The difference in the total molar rates of flow into and out of the reaction zone is measured and indicated to determine the concentration of the selected gas.

15818

LOW ENERGY COUNTING CHAMBERS. P. M. Hayes (to U. S. Atomic Energy Commission). U. S. Patent 2,925,509. Feb. 16, 1960.

A beta particle counter adapted to use an end window made of polyethylene terephthalate was designed. The extreme thinness of the film results in a correspondingly high transmission of incident low-energy beta particles by the window. As a consequence, the counting efficiency of the present counter is over 40% greater than counters using conventional mica end windows.

15819

CONTROL LIMITER DEVICE. J. A. DeShong (to U. S. Atomic Energy Commission). U. S. Patent 2,927,070. Mar. 1, 1960.

A control-limiting device for monitoring a control system is described. The system comprises a condition-sensing device, a condition-varying device exerting a control over the condition, and a control means to actuate the condition-varying device. A control-limiting device integrates the total movement or other change of the condition-varying device over any interval of time during a continuum of overlapping periods of time, and if the total movement or change of the condition-varying device exceeds a preset value, the control-limiting device will switch the control of the operated apparatus from automatic to manual control.

15820

NON-BLOCKING STABILIZED FEED BACK AMPLIFIER. E. Fairstein (to U. S. Atomic Energy Commission). U. S. Patent 2,927,165. Mar. 1, 1960.

A plural stage nonblocking degenerative feed-back amplifier was designed particularly suitable for counting circuits because of the stability and linearity in operation, characterized by the fact that the initial stage employs a cathode coupled input circuit fed from a cathode follower and the final stage has a time constant greater than those of the other stages.

15821

RADIATION MEASURING DEVICES. G. M. B. Bouricius and G. K. Rusch (to U. S. Atomic Energy Commission). U. S. Patent 2,929,932. Mar. 22, 1960.

A radiation-measuring device is described having an a-c output. The apparatus has a high-energy particle source responsive to radiation flux disposed within a housing having a pair of collector plates. A potential gradient between the source and collector plates causes ions to flow to the plates. By means of electrostatic or magnetic deflection elements connected to an alternating potential, the ions are caused to flow alternately to each of the collector plates causing an a-c signal thereon.

Materials Testing

15822 HW-48754

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SOME STUDIES ON ULTRASONIC TESTING WITH LAMB WAVES. R. L. Mancuso. Feb. 25, 1957. Decl. Mar. 31. 1960. 14p. OTS.

Experimental data are given describing the Lamb Wave response to different size unbonded areas in fuel elements as a function of crystal position. While conditions can be found for obtaining an amplitude response which varies with void width, the response is also found to be dependent to some extent on void area and depth below the surface. The results indicate that discriminating the size of unbonded area in fuel elements by the Lamb Wave technique is less reliable than the count-rate method used in the present Hanford Bondtester. However. use of the Lamb Wave method with close crystal spacing plus the countrate circuits for size discrimination can offer advantages in simplification of the Bondtester circuits. (auth)

15823 SCTM-49-57(14)

Sandia Corp., Albuquerque, N. Mex.

A DROP-TESTING DEVICE USED FOR SMALL-SCALE, DYNAMIC, CUSHIONING EXPERIMENTS IN SANDIA CORPORATION'S "COMPONENT RECOVERY PROGRAM." W. J. Halpin. Mar. 27, 1957. 31p. Contract AT(29-1)-789. OTS.

Since the beginning of Sandia Corporation's "Component Recovery Program" in late 1954, the possibility of using certain types of materials for cushioning purposes has been recognized. As a result, considerable effort has been made to investigate the compression characteristics of these materials, particularly to determine whether such characteristics are dependent on the rate of loading. This report describes an 11-foot drop-testing device which was built and put into operation early in the program so that initial testing could be done on small-scale cushion samples at loading rates up to 25 ft/sec. (auth)

15824

A NEW FATIGUE MACHINE FOR ALTERNATING BEND

TESTS AT HIGH TEMPERATURE IN VACUO OR IN A CONTROLLED ATMOSPHERE. J. de Fouquet, R. Jacquesson, and P. Laurent. Mém. sci. rev. mét. 57, 62-6 (1960) Jan. (In French)

The study of high-temperature fatigue cannot be made in normal atmospheres because of the oxidation of the metal which takes place more or less rapidly thus disturbing the observations and changing the actual mechanism of fatigue. For this purpose, a new testing machine has been devised which allows alternating bend fatigue to be studied at temperatures from normal up to 1,000 deg C in vacuo or in a controlled atmosphere, the frequency of the oscillations varying from 10 to 50 cycles per second. (auth)

15825

IMPACT TESTING AT HIGH TEMPERATURE. A. J. Bush (Westinghouse Electric Corp., East Pittsburgh, Penna.). Metal Progr. 77, No. 6, 98-101(1960) June.

A system for the heating of Charpy or Izod specimens in the testing machine was developed in order to avoid the temperature drop occurring with removal from the furnace for testing. In this system, four 350-watt cartridge resistance heaters surround the specimen; after the specimen is heated to the desired temperature, they are removed just before the test (release of pendulum). Temperatures of 1000 to 1200°F can be attained in 10 to 30 min. Calibration is necessary in order to relate notch and surface temperatures since the temperature difference at $\frac{1}{4}$ inch on either side of the notch is ca. 5° at 400°F and 25° at 1150°F. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

15826 BNL-596

Brookhaven National Lab., Upton, N. Y.

A STUDY OF THE WIND PROFILE IN THE LOWEST 400 FEET OF THE ATMOSPHERE. Progress Report No. 5 [for] October 16, 1959–January 15, 1960. Irving A. Singer. Jan. 1960. 46p. DA Project No. 3A99-07-001-03. Contract R-65-8-99812-SC-04-91. OTS.

A study is in progress to obtain a reliable estimate of the wind profile between 37 and 355 feet above ground, based on a single wind measurement at 37 feet and associated simple measurements or observations. One type of predictor used is based on a simple multiplication of the wind speed average and one height by a constant to obtain the corresponding average at the other height. A second predictor is based on a procedure that gives the best prediction possible by linear methods. This second method, although not applicable under actual conditions, provides a benchmark by which any other predictor may be evaluated. Examples of analyses are presented which were made by examining the variance or standard deviation of the difference between the predicted value of the wind speed and the observed time. The mathematical models used are described, and data from various types of turbulence conditions are analyzed. (C.H.)

15827 RME-2058

Grand Junction Operations Office. Salt Lake Branch Office, AEC.

URANIUM OCCURRENCES IN THE MOJAVE MINING DISTRICT, KERN COUNTY, CALIFORNIA. Harry E. Nelson. Feb. 1957. 27p. OTS.

The Mojave mining district is located about 12 miles southwest of Mojave, California. Several areas of anomalous radioactivity were discovered here by the U. S. Atomic Energy Commission (AEC) and published on an anomaly map in the spring of 1954. Two of these anomalies were exposed by surface excavation. Anomaly No. 2, the Dono-Han prospect, was developed by an incline to a depth of 20 feet. Low-grade uraniferous material was stockpiled. Anomaly No. 3, the Verdi Development prospect, was developed by open-pit mining. The ore minerals are autunite, meta-autunite, and uranophane. Gangue minerals, with the exception of iron oxide, are absent. The uranium minerals are associated with northwest-striking faults and slips that cut Jurassic (?) quartz monzonite. A later andesite-porphyry dike and several quartz-monzonite aplite zones are found in close proximity to the uranium minerals. Economic potential of the area appears to be limited, although further work may expose additional reserves. (auth)

15828 SC-4144(TR)

Sandia Corp., Albuquerque, N. Mex.

A STUDY OF NEVADA TEST SITE WIND VARIABILITY. Jack W. Reed. Mar. 10, 1958. 43p. OTS.

Wind observations collected at Yucca Flat since 1951 are analyzed for timewise variability. Variability functions of altitude, season, wind speed, and vector wind are described. Derived variability parameters are incorporated into calculations of fall-out safety probability for NTS operations. (auth)

15829 JPRS-2473

THE DISTRIBUTION OF A HEAVY POLYDISPERSED AEROSOL IN A TURBULENT ATMOSPHERE AT A LONG DISTANCE FROM AN INSTANTANEOUS POINT SOURCE. I. L. Karol' and A. Ya. Pressman. Translated from Inzhener. Fiz. Zhur., Akad. Nauk Belorus. S.S.R. 2, No. 9, 83-91(1959). 13p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4634.

15830 SCL-T-306

THE PROCESSING OF INSTRUMENT OBSERVATIONS OF EARTHQUAKES BY MEANS OF THE EPICENTRAL METHOD. (Ob Obrabotke Instrumental 'nykh nabl 'udeniĭ nad Zemletr 'aseniiami Metodom Epitsentralei). S. I. Golenetskiĭ. Translated by Marcel I. Weinreich (Sandia Corp.) from Trudy Inst. Seismol., Akad. Nauk Tadzhek. S.S.R. 54, 41-56(1956). 18p. JCL or LC.

The method of epicentrals is developed and applied to the processing of observations at both nearby and distant stations pertaining to three strong Central Asian earthquakes. (C.J.G.)

15831 SCL-T-310

METHOD OF DETERMINING WIND VELOCITIES FOR MEASURING WIND LOADS (PRESSURES) ON STRUCTURES. (Metodika Opredeleniya Raschetnykh Skorosteĭ Vetra dl'a Proektirovaniya Vetrovykh Nagruzok na Stroitel'nye Sooruzheniya). L. E. Anapol'skaya and L. S. Gandin. Translated by Marcel I. Weinreich (Sandia Corp.) from Meteorol. i Gidrol. No. 10, 9-17(1958). 13p. JCL or LC.

The statistical law-like regularities of ground level wind distribution are examined. Information on this phase of meteorology is useful in estimating the wind loads to which facilities such as television towers, radio relay lines, and high voltage transmission installations are likely to be subjected. (J.R.D.)

15832

INTEGRATED RADIOMETRIC PROSPECTING. I. M. Tenenbaum. Atomnaya Energ. 8, 336-9(1960) Apr. (In Russian)

Efficient applications and problems of integrated radiometric methods under field conditions are described. The planning of radiometric work and simultaneously developing ore deposits is discussed. Other practical suggestions of interest to geologists, miners, geophysicists, and other personnel occupied in prospecting, developing, and mining mineral deposits are presented. (R.V.J.)

15833

SOME ASPECTS OF AERIAL γ-SURVEYS IN WOODED AREAS. G. N. Kotel'nikov and N. I. Kalyakin. Atomnaya Energ. 8, 370-2(1960) Apr. (In Russian)

The screening effects of wooded surfaces on aerial γ prospecting for uranium mineral deposits are discussed. (R.V.J.)

15834

THE CRYSTALLINE STRUCTURE OF METATORBERNITE. E. S. Makarov and K. I. Tobelko (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 87-9(1960) Mar. 1. (In Russian)

The crystal structure of a dark green, flat specimen of metatorbernite was studied. The x-ray rotation pictures showed constant tetragonal lattice values of a = 6.95 ± 0.02 A and c = 17.26 ± 0.06 A. The picnometric density is 3.79 g/cm^3, which indicates the formula $Cu(UO_2)_2(PO_4)_2 \cdot 8H_2O$. The first approximation of atom coördinates for uranium, copper, phosphorus, and some atoms of oxygen were found with the interatomic vector projections at (001) and (100). In general the atomic position of uranium and phosphorus coincided with the respective atoms in $Ca(UO_2)_2 \cdot (PO_4)_2 \cdot 8H_2O$. The chemical formula for metatorbernite is found to be: $Cu^{2+}[(UO_2)_2 \cdot (PO_4)_2]^{2-} \cdot 8H_2O$. (R.V.J.)

15835

INVESTIGATIONS ON THE GEOCHEMISTRY OF STRONTIUM IN HYDROTHERMAL DEPOSITS. Heinrich Gundlach (Bundesanstalt für Bodenforschung, Hanover). Geol. Jahrb. 76, 637-711(1959). (In German)

With respect to the earth's crust, the hydrothermal deposits are relatively rich in Sr. The amount of Sr is between 0.1 and 0.7%, a higher value than that obtained previously. There is no relationship between the geochemistry of Ca and of Sr in the hydrothermal beds. As yet no hydrothermal deposits are known in which Sr but no Ca occurs. The distribution of the Sr in hydrothermal layers in the individual minerals which take Sr into the lattice is dependent on the respective lattices, the formation temperature, and the ratio of the activities of the anions to each other. The Sr content in the Ca minerals is, in general, below the Clark value. For the minerals taking up Sr, the Sr content is log normal. Only in rare cases were the conditions necessary for the deposition of pure Sr minerals present. (tr-auth)

15836

CRYSTAL CONSTITUTION OF URANINITES AND NASTURANES (PITCHBLENDES). E. S. Makarov, I. M. Lipova, I. F. Dolmanova, and A. A. Melikyan (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow). Geokhimiya No. 3, 193-213 (1960). (In Russian)

A mineragraphic investigation of uraninites was carried out; the chemical composition, density, and lattice constants were determined; numbers of atoms and formula units in the unit cell were calculated; the crystal structure was determined by neutron diffraction and the manner of alteration of the structure owing to the degree of oxidation was found. Uraninites and pitchblendes were established to have a primitive cubic lattice related to space group T_h^6–Pa3 in contrast to a face-centered lattice of fluorite type assumed earlier. For all the studied specimens the number of atoms in the unit cell is lower than 12. This value is in line with the fluorite type structure. Atom coordinates for the $UO_{2.33}$ pitchblende including 3.15 formula units in the unit cell are listed. According to the new structure the U^{6+} atoms in uraninites and pitchblendes form UO_2^{2+} groups and the uranium–oxygen distance is 1.90 Å. Excess oxygen atoms occupy the interstices of the lattice 4 (a) and 4 (b) to compensate the charge of the uranyl groups. The amount of these atoms is equal to the number of the U^{6+} atoms. With the increase of the oxidation degree of uraninites and pitchblendes the numbers of uranyl groups and excess oxygen atoms in the structure are increasing while the number of atoms (N) and corresponded formula units (Z) in the cell are decreasing. This results in the decrease of the cell dimensions and the value of density. On the grounds of this and other data the chemical composition of uraninites and pitchblendes is expressed by the formula $(U^{4+}, U^{6+}, Pb, Th, TR, Ca)O_{1.90-2.50}$. (auth)

15837

DEPENDENCE OF THE ZIRCONIUM AND HAFNIUM BEHAVIOUR ON THE PETROCHEMICAL PARAMETERS OF MAGMATIC AND ALKALINE-METASOMATIC ROCKS. I. D. Shevaleevskii, A. S. Pavlenko, and E. E. Vainshtein (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR, Moscow). Geokhimiya No. 3, 222-30(1960). (In Russian)

The nature of Zr and Hf distribution in rock-forming minerals and in mineral-concentrators of different petrochemical types is shown. The more basic hafnium preferably concentrates in dark-colored minerals. In this connection, in mineral-concentrators of rocks of the same petrochemical type, the Zr/Hf-ratio increases with the augmentation of the content of dark-colored minerals. This factor is determinant for rocks saturated and oversaturated with silica. In nepheline-containing rocks the difference in the basicity of Zr and Hf increases with the decrease of the alkaline content, i.e., from agpaitic nepheline syenites to miascites. In alkaline-metasomatic processes, on the condition that the composition of the solution is essentially potassic, a sharper Zr and Hf separation occurs than in the case of a sodic composition. (auth)

15838

ABSOLUTE AGE OF "MONASTIC" GRANITES OF KALBA. L. Ya. Atrashenok, G. V. Avdseiko, A. Ya. Krylov, and Yu. I. Silin (Khlopin Radium Inst., Leningrad). Geokhimiya No. 3, 278-9(1960). (In Russian)

The "absolute" age of monastic granites in the Kalba Ridge of Alma-Ata was estimated by averaging the lead and helium age of accessory monacites and the argon age of granite. The most probable age is estimated to be 300 to 320 million years. The data are in good agreement with data on most Hertian granites of Kazakhstan, Altai, and Tyan-Shan which belong to lower Devonian age. (R.V.J.)

15839

LONGITUDINAL AND TRANSVERSE WAVE TRAVEL TIMES CALCULATED ACCORDING TO THE DATA ON NUCLEAR EXPLOSIONS IN MARSHALL ISLANDS. S. D. Kogan (Inst. of Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 3, 371-80 (1960) Mar. (In Russian)

The true wave travel times in the western region of the Pacific are 2 sec less for P waves, 5 sec less for P P

waves, and 3 sec less for PcP waves than those given by the Jeffreys-Bullen hodograph. The travel times of transverse waves are 4 to 5 sec higher. The corrections for longitudinal waves are based on the absence of a granite layer in the Pacific Ocean, while for the transverse wave it must be related to the value of the travel rate of S waves in the upper layer. (R.V.J.)

15840

AGE OF EMPLACEMENT OF GRANITES. W. Compston, P. M. Jeffery, and G. H. Riley (Univ. of Western Australia, Nedlands). Nature 186, 702-3(1960) May 28.

A method is described for total-rock analysis in determining the age of mineral components of granite rocks. Analytical results for five total-rock and four mineral samples are tabulated. The present-day ratio of strontium-87/strontium-86 and rubidium-87/strontium-86 was measured. (C.H.)

15841

Geological Survey, Washington, D. C.
EPIGENETIC URANIUM DEPOSITS IN THE UNITED STATES. W. I. Finch, I. S. Parrish, and G. W. Walker. Miscellaneous Geologic Investigations Map I-299. 1959. 3p. $1.00(USGS).

15842

Geological Survey, Washington, D. C.
PHOTOGEOLOGIC MAP OF THE NOTOM-2 QUADRANGLE, WAYNE COUNTY, UTAH. W. R. Hemphill. Miscellaneous Geologic Investigations Map I-302. 1959. 1p. $0.50 (USGS).

15843

Geological Survey, Washington, D. C.
GEOLOGY OF THE THOMAS RANGE FLUORSPAR DISTRICT, JUAB COUNTY, UTAH. M. H. Staatz and F. W. Osterwald. Geological Survey Bulletin 1069. 1959. 101p., 8 illus. GPO

The Thomas Range fluorspar district is an area of about 34 square miles surrounding Spors Mountain in central Juab County, 46 miles northwest of Delta, Utah. Almost all the fluorspar deposits have an abnormally high U content. All but 1 of the 7 fluorspar veins and pipes that contained over 0.050% U are on the southern end of Spors Mountain. Fluorspar deposits are of three types: oval to irregular pipes, veins, and disseminated deposits. Analyses of 155 fluorspar samples revealed a range of from 0.003 to 0.33% of U. The highest grade U samples came from the Bell Hill, Harrisite, Eagle Rock, Lucky Louie, and two small prospects. (W.L.H.)

15844

Geological Survey, Washington, D. C.
STRATIGRAPHY OF THE INYAN KARA GROUP IN THE BLACK HILLS. Karl M. Waggé. Geological Survey Bulletin 1081-B. 1959. 82p. $0.40(GPO).

Darton's subdivision of beds, originally called Dakota in the Black Hills, proved difficult to apply outside of a limited area in the southeastern Black Hills in which the names were first applied. As early as 1930 the principal subdivisions, the Lakota, Fuson, and Fall River (Dakota of Darton) formations were placed in the Inyan Kara group because they could not be distinguished consistently as separate units. Early miscorrelation of the Fall River (Dakota) with the Dakota sandstone of southeastern Colorado led to confusion in the application of Darton's terminology outside of the Black Hills. Stratigraphic studies of the Inyan Kara group reveal a basic twofold lithogenetic subdivision which was recognized in equivalent beds elsewhere in the western interior region. Deposits of the lower part of this twofold division are dominantly sandy sediments of varied continental facies and are allied lithogenetically with the underlying Morrison formation. Deposits of the upper part are dominantly sandy sediments of marginal marine facies allied lithogenetically and gradational with the overlying marine Skull Creek shale. The contact of the two parts is a transgressive disconformity of regional extent marking the initial incursion of the Cretaceous sea. The subdivision and nomenclature of the Inyan Kara group is adjusted to conform to this twofold lithogenetic division by refining the definition of the Fall River formation so that it corresponds to the upper part, and by extending the term "Lakota" to include the entire lower part. The transgressive disconformity becomes the contact of the Lakota and Fall River formations. The Inyan Kara group is retained to include these two formations. The Minnewaste, called a formation by Darton, is recognized as a local limestone member of the Lakota. Use of the name Fuson as a member of the Lakota is considered permissible only where the Minnewaste limestone member is present. Because of the strictly local nature of much of the Inyan Kara group neither its name nor the names Fall River and Lakota should be used outside of the Black Hills region. The sequence of Lakota rocks in the southern part of the Black Hills is markedly different from that in the northwestern part. Additional beds are added progressively at the base of the formation as it thickens eastward and southeastward. The relationship of these beds to the underlying Morrison is not completely understood, but they do not interfinger. The base of the Lakota is an admittedly arbitrary, indefinite, and inconstant boundary generally drawn at the base of the first appreciable sandstone bed above the Sundance formation, the local, distinctive Unkpapa sandstone excepted. The base of the first dark-gray or black claystone above the variegated marlstone beds of the Morrison serves as a convenient contact in the absence of thick sandstone bodies. More precise definition of units in the complex of continental facies making up the Morrison-Lakota interval must await more detailed study of these closely related formations. Included plant remains indicate that the Lakota is Early Cretaceous in age. The contact of the Lakota and Fall River formations is a surface of disconformity that can be found throughout the Black Hills. Its aspects varies from place to place depending on the rock types that are locally in contact; dark-gray laminated silt-stone is the commonest basal Fall River rock and light-colored claystone or clayey siltstone the commonest upper Lakota rock. Scattered small spherulites of siderite characterize the upper several feet of the Lakota beneath the contact. The major features of Fall River rocks extend throughout the Black Hills area. The chief variations within the formation are the presence of a thin tongue of continental claystone and siltstone in the southern and eastern parts of the Black Hills and the increase in thickness of included massive sandstone subunits in the southern part. Fossils from the Fall River fromation are not diagnostic as to age, but the formation is gradational with the overlying Skull Creek shale, which contains an Albian fauna. (auth)

15845

Portugal. Junta de Energia Nuclear, Lisbon.
ACERCA DUM MÉTODO DE CALCULAR RESERVAS DE MINÉRIO DE URÂNIO NOS JAZIGOS FILONEANOS A PARTIR DE SONDAGENS. Memoria No. 24. (Concerning a Method of Calculating the Uranium Ore Reserves in Vein Deposits Starting from Drillings. Report No. 24). L. H. Brito de Carvalho. 1960. 46p.

The method of the volumes of influence is based on the hypothesis that in a well conducted sampling, each sample

represents the whole of its volume of influence, which is defined as the geometric locus of the points which are nearer the sampling question than any other neighboring sample. In particular, it is assumed that each volume of influence thus defined has the same contents as the sample to which it corresponds. The method, which is frequently used in the estimation of sedimentary deposits sampled by means of pits or drillings, is perfectly applicable theoretically to lode deposits sampled by drilling in particular to the lode deposits of uranium. The irregular and capricious nature of the distribution of the mineralization, well known in these deposits, the uncertain ties of the structural interpretation and the degree of accuracy in the measurements which it is possible to obtain in practice, if they do not prevent the application of the method, nevertheless impose limitations to their field of employment and to the meaning of the numbers obtained. Even when it can be used, the method gives results, with considerable errors which are due first of all to the density of the net-work of drillings. Economic considerations however impose limits on the density of the net-work. The analysis of the errors shows that it is possible to increase the approximation of the results by better means of gathering the samples and increasing the precision of the measurements. The determination of the angles of the drillings is particularly important and its precision can be increased. Although they have less influence in the final error some of the other measurements can also be made more accurate. However one must not forget that after a certain point the improvements in the method become deceptive because large intervals between the drillings for economic reasons and irregular characteristics of the deposits do not allow more than grossly approximate numbers. In spite of all these limitations the method has its interest because it can be used for a provisional evaluation of the deposits at relatively low cost. To have an idea of its real value one must compare its results with those obtained from mining, in a sufficiently large number of deposits of each type—an experience which we do not yet have. (auth)

HEALTH AND SAFETY

15846 A/AC.82/G/L.279

Germany. Bundesministerium für Atomkernenergie und Wasserwirtschaft.

THE RECENT INCREASE IN THE C^{14} CONTENT OF THE ATMOSPHERE, THE BIOSPHERE AND THE OCEAN. Report on the Measurements of the C^{14} Laboratory, Zweites Physikalisches Institut der Universität, Heidelberg. K. O. Münnich and J. C. Vogel. Aug. 21, 1959. 10p.

Measurements on samples of air, ground water, and biological materials collected in the Federal Republic of Germany during 1958 and 1959 showed an increase in carbon-14 content during the period. Data are also included on the carbon-14 content of samples of ocean water collected at three locations in the North Atlantic. (C.H.)

15847 ARCRL-2

Gt. Brit. Agricultural Research Council. Radiobiological Lab., Grove, Berks, England.

STRONTIUM 90 IN MILK AND AGRICULTURAL MATERIALS IN THE UNITED KINGDOM, 1958-1959. Report No. 2. 1960. 102p. Her Majesty's Stationery Office, London.

Data are summarized on the level of strontium-90 found in samples of milk, vegetation, soil, bones, and other biological materials collected throughout Great Britain during 1958 and 1959. (C.H.)

15848 BIO-05-59

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.

DATA ON RADIOACTIVE FALL-OUT, COLLECTED IN ITALY (JULY–DECEMBER 1958). Apr. 2, 1959. 26p. (A/AC.82/G/L.262).

Data are tabulated on the radioactivity of samples of air and water collected at various locations throughout Italy between July 1958 and January 1959. (C.H.)

15849 ERDL-1613-RR

Army Engineer Research and Development Labs., Fort Belvoir, Va.

DECONTAMINATION OF WATER CONTAMINATED WITH PLUTONIUM. Maurice Pressman and Don C. Lindsten. Jan. 12, 1960. 97p. Project No. 8-75-07-460.

This report covers the tests conducted on the decontamination of water contaminated with plutonium. The report concludes that the Army Mobile Water Purification Unit is capable of removing essentially all particulate plutonium from water by the standard processes of coagulation with ferric chloride and limestone, disinfection, and diatomite filtration; the Army Mobile Water Purification Unit is capable of removing 72% of the plutonium from contaminated tap water in which most of the plutonium is in soluble form. The percentage is increased to 89 by the addition of 600 ppm activated carbon and to 97.5 percent by the addition of 100 ppm of clay to clear raw water and by raising pH to 11.4; mixed-bed ion-exchange resin and high-capacity cation-exchange resin on the hydrogen cycle are both capable of removing over 99% soluble plutonium from contaminated water; a proposed Army squad method of removing CBR agents from water is capable of removing over 99.9 percent plutonium activity even when in the soluble form; cation-exchange water-softening unit is ineffective; alum coagulation and sand filtration is 95% effective; activated carbon in high dosage is an effective adsorbent; and lime-soda softening is 97% effective. (auth)

15850 FZM-25-022

Convair, Forth Worth, Tex.

BACKGROUND INFORMATION FOR NUCLEAR AIRCRAFT SAFETY ANALYSIS PROGRAM. Nov. 22, 1957. 127p.

A summary is presented of the status in 1957 of studies on the hazards associated with nuclear-powered aircraft. The nuclear consequences of a typical and an extreme reactor accident are postulated. A statistical prediction is made of the probable average number of bystanders affected by the postulated aircraft accidents. The effect of the worst credible accident is analyzed. A discussion is included of what would have happened if the B-47 bombers had been nuclear-powered between 1952 and 1955. (C.H.)

15851 NP-8741

Ford Instrument Co., Long Island City, N. Y.

FALLOUT PREDICTOR. Quarterly Report No. 4 [for] April 1, through June 30, 1959. R. Bailey, W. Cannon, A. J. Cassano, M. Polan, A. Richter, and S. Smilowitz. July 15, 1959. 147p. DA Project No. 3-99-04-112. Contract DA-36-039-SC-78185.

A model is proposed for the bomb cloud of a burst on the surface of deep water. Underwater bursts are considered and activity-particle size distributions are presented. The effects of meteorological parameters on the stabilized height of the bomb cloud are discussed. The problem of precipitation at or near ground zero is reviewed. The effect of precipitation on the height of the bomb cloud is investigated. A fall-out mechanism is

proposed for a bomb detonated in the rain. The factors necessitating division of the visible bomb cloud are discussed and methods of obtaining vertical, horizontal, and particle size division are described. A table is prepared giving the total number of cloud wafers to be treated as function of bomb yield. The feasibility of the use of a constant set of particle settling rates is investigated. The small scale diffusion of falling particles is discussed in its relation to the fall-out from a low yield bomb cloud. Two methods of wind interpolation are presented and calculated results are compared with AEC weather data from the JANGLE test series. The shear effect on a cloud wafer due to wind variation with height is analyzed. (auth)

15852 NP-8742

Ford Instrument Co., Long Island City, N. Y.
FALLOUT PREDICTOR. Quarterly Report No. 5 [for] July 1, through September 30, 1959. R. Bailey, W. Cannon, A. J. Cassano, M. Polan, A. Richter, and S. Smilowitz. Oct. 15, 1959. 93p. DA Project No. 3-99-04-112. Contract DA-36-039-SC-78185.

Fall-out resulting from an underground burst is discussed. The mechanism of fall-out from an elevated burst is described and an associated cloud model is presented. The variation of atmospheric diffusion of particles as a function of altitude is considered. Two methods for including diffusion effects for low yield weapons are presented. A modification of the previously proposed method of dividing the visible bomb cloud is described. The revision simplifies the cloud division with respect to computer applications. The particle settling rates used by the Rand Corporation are examined in detail. Simplified mathematical expressions are developed describing the particle settling rates for the entire range of motion. The problem of scavenging of fall-out particles, after deposition, by wind and rain is considered. A detailed analysis is made of the shear effect on a cloud wafer due to wind variations with height and with location in a horizontal plane. A method of representing the isodose contours in terms of probabilities is presented. The form, extent, and selection of input data to the predictor are briefly discussed. A procedure for evaluating the Ford cloud model and prediction techniques is described. (auth)

15853 NP-8743

Ford Instrument Co., Long Island City, N. Y.
FALLOUT PREDICTOR. Quarterly Report No. 6 [for] October 1, through December 31, 1959. R. Bailey, W. Cannon, A. J. Cassano, M. Polan, A. Richter, and S. Smilowitz. Jan. 15, 1960. 84p. DA Project No. 3-99-04-112. Contract DA-36-039-SC-78185.

A new relationship describing the mushroom diameter and vertical thickness as a function of weapon yield is developed based on cloud-photography data. A method of calculating the horizontal displacement of a rising cloud is presented. Expressions are developed from empirical data describing the Reynolds number as a function of the product of the drag coefficient and the square of the Reynolds number. A method for calculating the settling rates for irregular particles is presented. Several methods are investigated for dividing the range of particle sizes in the burst cloud into distinct size groups for computing the fall-out patterns. The wafer displacement calculation methods are reviewed followed by a discussion of several new calculation methods of obtaining fall-out patterns more quickly for times close to the burst time. Flow charts for the determination of the vertical and horizontal divisions of the visible bomb cloud are presented. The mathematical expressions describing the horizontal division array method are derived in the appendix. The effect of errors in the input data on the output fall-out patterns is investigated. Flow charts are presented describing the method of obtaining the specified predictor outputs. (auth)

15854 NP-8751

Corps of Engineers.
DESIGN OF STRUCTURES TO RESIST THE EFFECTS OF ATOMIC WEAPONS. MULTISTORY FRAME BUILDINGS. Jan. 15, 1960. 194p. (EM-1110-345-418).

This manual is one of a series issued for the guidance of engineers engaged in the design of permanent type military structures required to resist the effects of atomic weapons. The material is based on the results of full-scale atomic tests and analytical studies. The methods and procedures presented were developed through the collaboration of many consultants and specialists. Data are included on the design and behavior of multistory frame buildings and two-story reinforced-concrete frame buildings under blast loads. (C.H.)

15855

MINIMIZING RADIATION HAZARDS. L. J. Cherubin (Knolls Atomic Power Lab., Schenectady, N. Y.). Chem. Eng. 67, No. 13, 105-10(1960) June 27.

Some aspects of radiation and human health are discussed with emphasis on industrial methods of measuring and monitoring radiation. The hazards and possible damage to the human body are pointed out together with a discussion of the nature of radiation (cosmic, gamma, and x rays; alpha, beta, and neutron particles). The different ways—external and internal—in which the human body can be exposed to radiation are given. Maximum permissible limits (MPL) are given for radionuclide concentration in the human organs and for irradiation of the body; the latter is set at 12 to 15 rem/yr for the organs and 75 rem/yr for the hands and feet. This is for controlled areas only; outside these areas, the MPL is reduced by a factor of ten. The principles of monitoring radiation are discussed at length together with an outline of various monitors, e.g., Geiger, BF_3, and scintillation counters. Means of monitoring personnel and recording the data are discussed. Sometimes the data can be filed on punched cards. (D.L.C.)

15856

RADIATION BURDEN TO PATIENTS DURING FLUOROSCOPY. R. Pape and J. Zakovsky (Röntgeninstitut des Wilhelminenspitales, Vienna and Ph. T. Prüfanstalt für Radiologie und Elektromedizin, Vienna). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. 92, 543-61(1960) May. (In German)

The radiation burden to patients during fluoroscopy was determined for 4 important types of screening, namely the examination of the chest, the stomach, the intestinal tract with enema, and the abdomen (examination of the appendix, pyeloscopy). The duration of the fluoroscopic examinations was determined on 167 outpatients and on 677 patients of a hospital. On the average shorter screening times were found on the outpatients. The measurement of the regional radiation burden was carried out on 143 toddlers, children of a later age and adults whereby the incident doses and exit doses were each measured with 8 measuring chambers. The average and maximum values were compared with the calculated doses (surface-dose rate times time). The average dose is of the order of 10 to 25% of the calculated doses. The dose to the skin of children amounts to

approximately a third to a half that to the skin of adults. For the determination of the gonad dose the latter was measured directly at the testicles of 143 male patients (adults and boys) whereas some direct measurements were made on the bodies of recently deceased female patients. The factors were determined which govern the relationship between the regional tissue dose (surface dose) and the gonad dose. In fluoroscopy of the chest of adults the gonad doses are below 1 mr, in fluoroscopy of the stomach usually below 100 mr, with enemas they may reach a few roentgen. The proportion of young persons in these investigations, however, is insignificant. Because of the lower kilovoltage used in the examination of children the gonads of the latter are usually exposed only to from $\frac{1}{10}$ to $\frac{1}{4}$ of these doses. A lead apron worn at the height of the hips affords an adequate protection of the gonads during the examination of the chest and shields the gonads from direct radiation on patients who undergo an examination of their stomach. The testicles may for all examinations best be protected by lead shields. In the hands of the well trained expert the genetic radiation burden entailed in fluoroscopy is thus considerably smaller than what is usually suspected. (auth)

15857

REMOVAL OF RADIOACTIVE PARTICULATES FROM AIR. P. A. F. White and S. E. Smith (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Research (London) 13, 228-33(1960) June.

High efficiency particulate filters used in radioactive ventilation and extract systems at A.W.R.E. are described, with reference to the developments on new filter media and in filter design which have taken place over the last 8 to 10 years. The most recent designs are non-combustible and show greatly increased economy over older types. Mention is made of the use of primary separators where the dust burden is high. (auth)

15858

AN EVALUATION OF EXISTING FALLOUT COLLECTION METHODS. George A. Welford and William R. Collins, Jr. (U. S. Atomic Energy Commission, New York). Science 131, 1791-3(1960) June 17.

Analysis of data shows that open vessels and funnels are equally efficient for fall-out sampling. (auth)

15859

Public Health Service, Washington, D. C.
RADIOLOGICAL HEALTH DATA MONTHLY REPORT, MAY 1960. 50p. $0.50(OTS).

Data are tabulated on radioactivity in samples of milk, air, raw surface waters, human bones, human and animal food, wheat, and bread collected throughout the United States during 1958 and 1959. (For preceding period see PB-161371-1.) (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

15860 TID-5905
Chicago. Univ., Chicago Midway Labs.
THE APPLICATIONS OF ISOTOPES TO INDUSTRIAL PROBLEMS. Progress Report No. 13 for period March 16 to April 15, 1960. Foster F. Rieke. Apr. 20, 1960. 12p. Contract AT(11-1)-712. OTS. (LAS-L-P161-13).

In studies of piston rings, a new nickel–radiocobalt inlaid piston ring was prepared. Co-plating of nickel and cobalt was not successful; however, results using nickel–cobalt alloy anodes are encouraging. In work on density and moisture content in coal, a determination was made of the gamma-energy spectrum presented to the G-M tubes in the Nuclear-Chicago depth density probe. A set of experiments is described in which a cesium source, a lead steel plug, and 1 × 1 in. NaI detector were mounted in a 55-gal drum of water. Pulse-height spectra for simulated probe geometries are shown along with data on counting rate plotted for related source-plug-detector geometries on a logarithmic scale. Pulse-height spectra were obtained using a Nuclear-Chicago probe in various media. Representative pulse-height spectra (center-to-center crystal source distance of 7 in. steel access tube) are shown along with data showing the effects of source and detector separation. Data are also tabulated and discussed on the comparative densities of materials according to various selected criteria. Work on in-place determination of moisture in coal by neutron moderation revealed that finding a liquid C, H, O compound which duplicates the hydrogen density and carbon-to-hydrogen ratios which are found in coal is improbable. (For preceding period see TID-5676.)

15861

NUCLEAR UNIT DETECTS MOISTURE IN FOUNDRY MOLDING SAND. H. A. Burley and M. J. Diamond (General Motors Corp., Warren, Mich.). Iron Age 185, No. 24, 124-5(1960) June 16.

Average moisture content in an entire batch of molding sand is measured by a gage using a fast-neutron source. The moisture content of a 3200-lb charge can be measured to ±0.05% at the 3% level in less than one minute. Film-badge and survey-meter results prove that the system is completely safe as long as the source is inspected regularly. (B.O.G.)

15862

REDOX POTENTIAL MEASUREMENTS IN IRRADIATED FOODS. Wilhelm Schmidt-Lorenz (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Naturwissenschaften 47, 208-9(1960). (In German)

An investigation was made to determine if redox potential measurements could replace the more complicated bacteria counting in the evaluation of microörganisms surviving the irradiation of food. Fish and meat were sealed in plastic bags in a vacuum and irradiated. The samples were stored at ±1°C and redox potential measurements and bacteria enumerations were made until the food spoiled. In the non-irradiated food the redox potentials decreased as the aerobic bacteria were multiplying and then started increasing with development of the anerobic bacteria. In the irradiated samples the redox potential increases during the time the bacteria development is inhibited. The velocity of the appearance of the positive potential is temperature dependent. The results indicate that redox potential measurements can replace bacteria counting in food research. (J.S.R.)

15863

APPLICATION OF RADIOISOTOPES IN POLAND IN 1958. Roman Broszkiewicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 4, 611-24 (1959). (In Polish)

The method and range of distribution of radioisotopes in Poland in 1958 is discussed. Some data concerning the distribution of radioisotopes are given. The questions concerning the application of radioisotopes in future years are summarized. (auth)

ISOTOPE SEPARATION

15864 TID-3554

Technical Information Service Extension, AEC. ISOTOPE SEPARATION BY GASEOUS DIFFUSION AND CENTRIFUGATION. A Literature Search. James M. Jacobs, comp. May 1960. 20p. OTS.

A total of 141 references to the unclassified report and published literature is included. (W.L.H.)

15865 TID-8522

Office of Operations Analysis and Forecasting, AEC. METHODS OF CALCULATING U-235 OUTPUTS AND CHARGES BY USE OF IDEAL CASCADE THEORY. Artha Jean Snyder. Feb. 1960. 43p. OTS.

A brief technical discussion of general theoretical considerations and calculation methods involving ideal cascades for isotope separation is given. A discussion of A.E.C. schedule of charges is included, and problems such as estimating the reduction of cascade top product output as a result of intermediate withdrawals, calculating charges for U^{235} burnup in reactors, and determining the effects of blending uranium of different assays are examined. (J.R.D.)

15866 JPRS-2460

SEPARATION OF ISOTOPES BY RECTIFICATION. RECTIFICATION OF METHANOL. Ya. D. Zel'venskii (Zel'venskiy), V. E. (Ye). Sokolov, and V. A. Shalygin. Translated from Nauch. Doklady Vysshel Shkoly, Khim. i Khim. Tekhnol., No. 2, 388-91(1958). 9p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 22033.

15867 JPRS-2475

THE SEPARATION OF STABLE ISOTOPES OF NITROGEN BY THE CHEMICAL EXCHANGE METHOD. [PART] I. G. M. Panchenkov, I. A. Semiokhin, A. A. Renzaeva (Renzayeva), V. V. Molchanov, and O. P. Kalashnikov. Translated from Zhur. Fiz. Khim. 31, 1352-9(1957). 14p. OTS.

Isotopic exchange between ammonia and ammonium nitrate in packed columns was investigated. It was found that the separation of nitrogen isotopes increased during lowering of partial pressure of ammonia in the columns. It was also found that during the separation of nitrogen isotopes, the packing material characteristics are important, and the size of the external surface is determined by the geometrical dimensions of the packing. (J.R.D.)

15868 JPRS-2479

THE CONCENTRATION OF ISOTOPES C^{13} AND O^{18} IN CARBON MONOXIDE BY THE THERMO-DIFFUSION METHOD. G. M. Panchenkov and V. D. Moiseev (Moiseyev). Translated from Zhur. Fiz. Khim. 30, 1662-7 (1956). 10p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 12551.

15869 JPRS-2626

A NEW METHOD FOR SEPARATING ISOTOPES. G. M. Panchenkov, A. M. Tolmachev, and V. B. Kondratova. Translated from Zhur. Fiz. Khim. 33, 734-5(1959) 4p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 11661.

15870

HEAVY WATER. L. Küchler (Farbwerke Hoechst A. G., Frankfurt am Main). Atom u. Strom 6, 35-40(1960) Apr. (In German)

Because of its low neutron cross section and good moderating capacity, heavy water is the best moderator known. However, its high cost has prevented extensive utilization. The methods used for the production of heavy water are reviewed beginning with the electrolysis of water. Fractional distillation of hydrogen or hydrogen-rich compounds is then discussed, and the flow scheme used at Farbwerke Hoechst AG for the production of heavy water by this method is given. The isotope exchange methods are then reviewed, and the flow scheme at use at the Savannah River Plant is described. (J.S.R.)

15871

SEPARATION OF THE ISOTOPES OF LITHIUM ON A SIMPLE ION-EXCHANGE COLUMN. G. M. Panchenkov, E. M. Kuznetsova, and L. L. Kozlov. Atomnaya Energ. 8, 368-70(1960) Apr. (In Russian)

Various salt solutions and lithium hydroxides were utilized in lithium isotopes separations in a simple ion exchange column. The rate of filtration varied from 1.5×10^{-3} to 5×10^{-3} ml/sec. The initial concentration of the solutions remained constant at 0.5 N. The isotopic ratio was 11.7 with hydrogen-form sulfocoal, $(1.7 \text{ to } 2.5) \times 10^{-2}$ cm grain, acting as ion exchanger. Tabulated data indicate an enrichment of Li^7 in all tested solutions. Variations in filtration rate from 1×10^{-3} to 5×10^{-3} ml/sec did not change the separation factor. The replacement of aqueous media by butyl alcohol did not affect the enrichment factor. The use of lithium chlorite in 80% butyl alcohol, in a 224-cm column with a flow rate of 5×10^{-3} to 1.5×10^{-3} ml/sec, increased the enrichment factor from 1.11 to 1.13. Additional tests were carried out using 1.2 N chloride and oxalic acids. The correlation of replacement and frontal chromatographs showed almost identical results. (R.V.J.)

15872

METHOD OF ISOTOPE CONCENTRATION. J. S. Spevack (to U. S. Atomic Energy Commission). U. S. Patent 2,787,526. Apr. 2, 1957.

An isotope concentration process is described which consists of exchanging, at two or more different temperature stages, two isotopes of an element between substances that are physically separate from each other and each of which is capable of containing either of the isotopes, and withdrawing from a point between at least two of the temperature stages one of the substances containing an increased concentration of the desired isotope.

15873

METHOD OF OPERATING A CALUTRON. P. H. Davidson (to U. S. Atomic Energy Commission). U. S. Patent 2,921,199. Jan. 12, 1960.

A method of operating an electromagnetic isotope separator of the calutron class is reported whereby uranium tetrachloride is produced at a controlled rate within the source rather than being introduced therein as was formerly practiced. This is accomplished by placing a uranium-bearing material, such as uranium metal, uranium trichloride, or uranium carbide in the charge receptacle of the calutron, heating this material to about 500°C, and reacting the heated material with chlorine gas to produce uranium tetrachloride vapor at a rate controlled by the chlorine gas flow into the source. The vapor is subsequently ionized by an electric arc and mass separated by conventional calutron methods.

15874

CALUTRON. E. J. Lofgren (to U. S. Atomic Energy Commission). U. S. Patent 2,922,044. Jan. 19, 1960.

An ion source suitable for use with isotope separators of the calutron class is described in which ion bombardment of source structural members is minimized to lessen deterioration. A hollow conducting block defines an arc chamber which has an ion exit opening in the form of a slot in one wall of the block. A charged electrode spaced from the opening applies an electrical field for withdrawing ions from within the block. To establish a field configuration whereby the impingement of ions on the walls of the block is reduced, the wall edges which define the slot opening are bevelled to converge in the direction of efflux of the ions.

15875

CONTROL SYSTEM FOR ISOTOPE SEPARATING APPARATUS. S. W. Barnes (to U. S. Atomic Energy Commission). U. S. Patent 2,922,882. Jan. 26, 1960.

A method is described for controlling the position of the ion beams in a calutron used for isotope separation. The U^{238} beam is centered over the U^{235} receiving pocket, the operator monitoring the beam until a maximum reading is achieved on the meter connected to that pocket. Then both beams are simultaneously shifted by a preselected amount to move the U^{235} beam over the U^{235} pocket. A slotted door is placed over the entrance to that pocket during the U^{238} beam centering to reduce the contamination to the pocket, while allowing enough beam to pass for monitoring purposes.

15876

METHOD OF ISOTOPE CONCENTRATION. T. I. Taylor and W. Spindel (to U. S. Atomic Energy Commission). U. S. Patent 2,923,601. Feb. 2, 1960.

A method of concentrating N^{15} in a liquid is described. Gaseous nitric oxide and at least one liquid selected from the group consisting of the aqueous oxyacids and oxides of nitrogen, wherein the atomic ratio of oxygen to nitrogen is greater than unity, are brought into intimate contact to cause an enrichment of the liquid and a depletion of the gas in N^{15}. The liquid is, thereafter, reacted with sulfur dioxide to produce a gas containing nitric oxide. The gas containing nitric oxide is then continuously passed in countercurrent contact with the liquid to cause further enrichment of the liquid.

15877

ELECTROMAGNETIC SEPARATION OF ISOTOPES. S. W. Barnes and C. M. Cantrell (to U. S. Atomic Energy Commission). U. S. Patent 2,923,822. Feb. 2, 1960.

An improved calutron receiver is described having two entrance slots leading to two electrically isolated pockets. A wall of the pocket intended to receive the heavier ions defines one side of the entrance slot to the other pocket and it is so constructed and arranged that the two sides of the wall are substantially equally exposed to the respective ion beams. Thus the per cent rejection of material entering the two entrance slots is the same for each slot.

MATHEMATICS AND COMPUTERS

15878 KAPL-2039

Knolls Atomic Power Lab., Schenectady, N. Y.

TRAM, A MONTE CARLO THERMAL NEUTRON CODE FOR THE IBM-704. M. A. Martino and W. W. Stone. June 19, 1959. 37p. Contract W-31-109-Eng-52. OTS.

TRAM is a three-dimensional neutron transport code for the Monte Carlo determination of spatial and spectral variations of the neutron population below 100 ev. The principal application of TRAM is expected to be the calculation of proportionate captures in the various regions of a reactor cell. (auth)

15879 KAPL-M-JA-6

Knolls Atomic Power Lab., Schenectady, N. Y.

KARE INPUT. J. A. Archibald, Jr. Apr. 7, 1960. 101p. Contract W-31-109-Eng-52. OTS.

It is planned that KARE will eventually be capable of doing complete life studies automatically. It is necessary to prepare complete input for the first problem of a life study only. When successive problems are run, it will be necessary to supply only those quantities for which abnormal changes are desired. Input cards, general input, boundary input, increment input, and region dependent input are discussed in detail. (W.D.M.)

15880 WAPD-TM-146

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

SN5001—AN IBM-650 CODE FOR STEADY-STATE THERMAL EVALUATION OF AN INSTRUMENTED MULTI-FUEL-PLATE SUBASSEMBLY. E. Arbtin and R. B. Westphal. Apr. 1960. 25p. Contract AT-11-1-GEN-14. OTS.

An IBM-650 computer program, SN5001, for the calculation of steady-state thermal conditions in the fuel plates and coolant of an instrumented multi-fuel-plate subassembly is described. The program is applicable for subcooled or bulk boiling coolant conditions and surface conditions of heating, local boiling, and film boiling, and can be used for data reduction or design. The derivation and a list of the heat conduction and coolant enthalpy equations and a description of the code sufficient for its use are contained. (auth)

15881 WAPD-TM-205

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

EURIPUS-3 AND DAEDALUS—MONTE CARLO DENSITY CODES FOR THE IBM-704. Harvey J. Amster, Heidi G. Kuehn, and Jerome Spanier. Feb. 1960. 94p. Contract AT-11-1-GEN-14. OTS.

EURIPUS-3 calculates the one-dimensional spatial density of neutrons slowing-down past a given energy in an infinite homogeneous medium consisting of hydrogen and one other isotope with arbitrary mass and energy-dependent differential-elastic and absorption cross sections. DAEDALUS determines the corresponding spatial distribution of angular integrals of an arbitrary function times the vector flux density. Spatial moments of all density functions are furnished directly. Although scattering angles are calculated by Monte Carlo, the spatial distributions and, in DAEDALUS, the energy distribution are obtained partly from an analytic treatment which, besides saving time, enables the output to be in the form of actual density functions at specified planes and energies, rather than histograms covering finite intervals. At certain steps in the computation of both the spatial and energy distributions, part of the analytic treatment is replaced by Monte Carlo in order either to maximize efficiency and/or to avoid round-off error. The neutron source may be monoenergetic with either isotropic or monodirectional angular distributions, or else the source may be that from deuterons bombarding deuterons. The volume displaced by a cylindrical tube from an accelerator to the source can be accounted for in the neutron first flight but not thereafter. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

15882 60-GL-72

General Electric Co. General Engineering Lab., Schenectady, N. Y.

A STUDY OF THE PHOTOELASTIC COATING TECHNIQUE. T. Slot. Apr. 1, 1960. 75p.

The photoelastic coating technique is evaluated for its potential towards the solution of elasticity and plasticity problems. Subjects discussed include: strain-optic response, model preparation, photographic technique, calibration, accuracy, and error sources. Two-dimensional experiments are described in which elastic and plastic strains were analyzed. Evidence is presented that the photoelastic coating technique is a powerful method for the analysis of surface strains in statically loaded structures. The technique has matured sufficiently to permit its use for relatively straightforward applications. More exploratory effort is needed to determine the suitability of the method for the study of advanced elasticity and plasticity problems. (auth)

15883 AD-227913

Westinghouse Electric Corp. Research Labs., Pittsburgh.

RESEARCH AND DEVELOPMENT IN HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 6 [for] April 27, 1959 through June 26, 1959. L. L. France. Aug. 1, 1959. 19p. Contract NOas-58852-C.

The study of the W–Ta–Hf and the W–Ta–Re ternary systems in the as-nonconsumably arc-melted condition was essentially completed. The investigation of the 2000°C isotherm of these phase diagrams is progressing and will be completed shortly. A rather cursory investigation of the Ta–Hf–Re and W–Hf–Re ternary systems was initiated, and preliminary work was started on Phase III of the program. (auth)

15884 AD-229486

National Research Corp., Cambridge, Mass.

DEVELOPMENT OF TANTALUM–TUNGSTEN ALLOYS FOR HIGH PERFORMANCE PROPULSION SYSTEM COMPONENTS. Quarterly Report No. 2 Covering Period July 10–October 9, 1959. M. L. Torti. 43p. NRC Project No. 11-1-032. Contract NOrd-18787.

Alloys ranging in composition from tantalum-10% tungsten to tantalum-98% tungsten were investigated. Successful solid propellant test firing data are reported on inserts of tantalum-10 and 20% tungsten. Fabrication procedures, recrystallization data, carbon effect, and hot hardness data are reported for the 10% tungsten alloy. Forgability experiments and hot hardnesses are reported for the 20 and 30% tungsten alloys. On the basis of small upset forging tests it appears that these alloys will forge well at 2500 to 3500°F. Attempts to cast 50 and 98% tungsten ingots were successful, but the alloys do not appear useable. Preliminary button investigations are noted. X-ray confirmation of the existence of TaC and Ta_2C surface layers after methane gas carburization of tantalum was obtained. (auth)

15885 AFSWC-TR-60-7

Colorado School of Mines Research Foundation, Inc., Golden.

PRACTICAL COUNTERMEASURES FOR THE PREVENTION OF SPALLATION. John S. Rinehart. Feb. 1960. 216p. Project No. 5776. Contract AF29(601)-1786.

The mathematics of propagation and superposition of transient stress disturbances in brittle-elastic materials is treated. Definitions and laws governing interface boundary conditions and the generation of compressional and shear stress waves are developed, including the partitioning of energy and momentum between incident and resultant waves for both normal and oblique incidence. The phenomenon of spallation in ideal materials is explained and a number of calculations of spall thickness and velocities are carried out for various assumed plane wave shapes. The effect of body shape upon the interference of plane, cylindrical, and spherical waves is shown through graphical illustration of experimental results compared with theoretical predictions in ideal substances. Reasons for changes in wave shape for a stress propagating in an isotropic, homogenous material are discussed and categorized: convergence or divergence in non-planar waves; changes in bulk modulus with stress; irreversibilities in form of minor inelastic deformation; extensive work on hardening; structural changes and phase changes. Qualitative observations are made in transient disturbances and spallation in real materials. Topics included are dependence of critical normal tensile fracture stress on state of stress of fracture, phase changes, structural changes (grain distortion, slip, bonding, twinning) and the resultant work hardening. The feasibility of developing components which resist spall is considered with primary emphasis on two techniques: a protective disposable surface layer, and reduction of incident stress through the use of laminants. Finally, the problems of predicting spall in real materials with complex shapes are summarized and recommendations given about how these problems should be approached and what experimental data are needed. (auth)

15886 BMI-1194

Battelle Memorial Inst., Columbus, Ohio.

A TRACER STUDY OF THE TRANSPORT OF CHROMIUM IN FLUORIDE FUEL SYSTEMS. Robert B. Price, Duane N. Sunderman, Meyer Pobereskin, and George D. Calkins. June 18, 1957. Decl. May 13, 1960. 44p. Contract W-7405-eng-92. OTS.

An experimental study was made of the mass transport of chromium in polythermal Inconel–fluoride fuel systems. The transport of chromium was followed by the technique of adding radioactive Cr^{51} to the system as either CrF_2 in the salt or as elemental chromium in the solid phase. The rates of diffusion of chromium in Inconel at 600, 700, 800, and 900°C were determined by an electropolishing technique. Polythermal studies were carried out by three methods, tilting capsules, thermal-convection loops, and pumping loops. Tilting-capsule experiments indicated that the preferred location for chromium deposition on the wall was in the region of maximum temperature but the conclusions were not clear cut. Thermal convection loops operated for 125 and 288 hr showed radioactivity profile which could be attributed to simple exchange, with some distortion in the 288 hr case. The duration of these experiments was evidently insufficient to allow equilibrium to be reached in the salt. A thermal-convection loop operated for 400 hr showed distortion in the exchange radioactivity profile which indicated a favorable position for chromium deposition at a point about 100°F below the maximum wall temperature, and on the upstream side of the flow. A pumping loop of Inconel and salt mix gave an activity profile which was very similar to that of the 400-hr thermal-convection loop, indicating a favorable deposition point 100°F below maximum temperature on the upstream side. One hypothesis advanced is that the long-term corrosion rate of chromium in the Inconel–salt system is controlled

by the rate of diffusion of chromium into the wall at a temperature about 100°F below the maximum temperature on the upstream side. (auth)

15887 HW-35717

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FAILURE OF STRESSED CYLINDERS. A. T. Taylor and L. M. Pedersen. Mar. 10, 1955. Decl. Mar. 31, 1960. 21p. OTS.

The effect of biaxial stressing on the bursting pressure of aluminum process tubes was investigated. It was demonstrated that true service failure of process tubing did not occur when the tube yielded, but only on reaching the ultimate strength of the material. (C.J.G.)

15888 HW-61329

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SPECIFICATIONS FOR REQUISITION G-385923-ZIRCALOY-4 FUEL JACKET TUBING. H. P. Oakes. Nov. 6, 1959. 6p. Contract AT(45-1)-1350. OTS.

Specifications are given for the procurement of Zircaloy-4 tubing for the fabrication of swaged UO_2 fuel elements and Pu-bearing fuel elements for the Plutonium Recycle Test Reactor. They include manufacture, chemical composition limits, and testing. (D.L.C.)

15889 HW-62447

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CRACKING OF IRRADIATED URANIUM BY RAPID COOLING. K. R. Merckx. Oct. 30, 1959. Decl. Feb. 3, 1960. 11p. Contract AT(45-1)-1350. OTS.

An investigation of the cracking of irradiated uranium by rapid cooling indicated that external reactor quenching produced internal cracks similar to those encountered during irradiation. The growth of the cracks was found to be dependent upon the number of quenching cycles. A study was made to determine the cycle, exposure, quench rate, and magnitude of temperature cycle dependency of crack growth. Experimental equipment and procedure are discussed. (J.E.D.)

15890 HW-62639

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

RELEASE OF INERT GASES FROM IRRADIATED URANIUM. (A Review of the Literature). D. L. Gray. Jan. 1960. 21p. Contract AT(45-1)-1350. OTS.

In reviewing literature on the inert gas—uranium systems, it was found that there is information on the escape of xenon and krypton from irradiated uranium. However, no direct information on the rate of inert gas diffusion in uranium was available. The data on xenon and krypton release during post-irradiation heating were then reviewed. It was found that there are two types of gas release as distinguished by evolution kinetics. One type occurs before gross swelling is evidenced and the other follows it. Consideration of the available data taken below approximately 900°C leads to the conclusion that the inert gas is not crossing the uranium surface in the classical sense. Additionally, as oxidation rate decreases, the apparent diffusion coefficient may also decrease. This trend indicates that the inert gas does not diffuse in the uranium lattice, diffuses very slowly, or the inert gas diffuses in the uranium lattice but encounters a barrier at the surface. (auth)

15891 LM/TAB-14

MSA Research Corp., Callery, Penna.

LIQUID METALS TECHNOLOGY ABSTRACT BULLETIN FOR THE PERIOD, JANUARY, FEBRUARY AND MARCH 1960. 13p.

A bulletin containing abstracts from current literature on liquid metals is presented. 35 listings. (J.R.D.)

15892 LMSD-288190

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

BERYLLIUM: A SEARCH OF THE LITERATURE 1957–1959. Kenneth D. Carroll, comp. Jan. 1960. 116p.

An annotated bibliography on beryllium resulting from a search of the literature released or reviewed during 1957 through 1959 is presented. Properties, fabrication, uses, and toxicology of beryllium are covered. 349 references. (J.R.D.)

15893 NAA-SR-4832

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

DEVELOPMENT OF FERRITIC STEELS FOR HIGH TEMPERATURE SODIUM SERVICE. PART I. 2.25 Cr–1 Mo–0.4 Cb–0.4 Ti EXPERIMENTAL ALLOY. W. C. Hayes and A. J. Birkle. May 15, 1960. 38p. Contract AT-11-1-GEN-8. OTS.

The commercially available ferritic chromium-molybdenum steels have several advantages over austenitic stainless steels. However, they have lower high-temperature strength, tend to decarburize in sodium systems containing austenitic steels, and require post-weld heat treatments. The purpose of this study is to develop a ferritic steel which has strength at 1100°F equal to Type 304 stainless steel, resists decarburization in sodium systems, and does not require a complex post-weld heat treatment. In the alloy development program at Atomics International, niobium and titanium are added to conventional chromium-molybdenum high temperature steels. A 2.25% Cr–1% Mo–0.4% Nb–0.4% Ti analysis was produced and evaluated. The results on this preliminary heat-of-steel show that the short time tensile, creep, and stress rupture properties are equivalent to Type 304 SS at temperatures at least up to 1100°F. In a sodium system this steel was found to be neutral to Type 304 SS with respect to carbon transfer. (auth)

15894 NDA-2140-2

Nuclear Development Corp. of America, White Plains, N. Y. and Carborundum Co., Niagara Falls, N. Y.

CARBIDE FUEL DEVELOPMENT. Phase I Report—Period of May 15 to September 15, 1959. R. Bolomey, S. Lazerus, J. Sapir, G. Sofer, H. Steinmetz, A. Strasser, J. Weisman, R. Dial, C. McMurtry, F. Saulino, and K. Taylor. Oct. 15, 1959. 107p. Project IV. Contract AT(30-1)-2303. OTS.

A combination of UC and PuC is proposed as a fuel which has the potential for reducing the fuel cycle cost of fast breeder reactors. A 3½ year development program is outlined, the purpose of which is to fabricate the fuel and evaluate the fuel properties having the most significant effect on fuel cycle cost. Analytical evaluation of PuC-UC in existing fast breeder reactors was completed with respect to heat transfer, physics, and cost. It was found that if certain reasonable fuel performance goals can be achieved, a fuel cycle cost reduction of a factor of 2 to 3 is possible. Facilities to handle and irradiate plutonium were designed and partially constructed. The facilities will be capable of synthesis and fabrication of carbides by dry powder techniques, chemical analysis, x-ray diffraction, metallography, fuel-clad compatibility studies, hardness testing, thermal cycling. Irradiation capsules were designed to irradiate clad fuel rod sections to 2% burnup at maximum fuel temperatures >1900°F. High purity, better than

99 wt.%, UC pellets were fabricated by pressing and sintering. Evaluation studies were initiated. The ease of dissolution of unirradiated UC was confirmed. Dissolution studies of UC with simulated fission products were initiated. (auth)

15895 NMI-1206

Nuclear Metals, Inc., Concord, Mass.

THE APPLICATION OF THE CHIP AND SHOT METHODS TO THE PREPARATION OF HOMOGENEOUS ALLOYS. D. S. Kneppel. Sept. 18, 1958. Decl. Mar. 31, 1960. 40p. Contract AT(30-1)-1565. OTS.

Chip method experiments were performed for the preparation of Th–9 wt.% U, U–10 wt.% Nb, and Al–16 wt.% U–0.2 wt.% B alloys. The work on Th–9 wt.% U indicated that the technique was applicable with only slight impairment of mechanical properties and slight increase of oxygen content. Experiments on U–10 wt.% Nb to produce a more corrosion-resistant alloy were not successful. The potential use of the chip method in fabricating alloys with a burnable poison such as boron appeared feasible. An aluminum alloy containing 16 wt.% U and 0.2 wt.% B showed good homogeneity. The shot method was used on an alloy of Al–25 wt.% U. The homogeneity and the mechanical properties of this alloy, when extruded, were superior to those of similar alloys produced by conventional melting and casting. Preliminary work on the blending of master alloys of a burnable poison (i.e., boron) with an aluminum–uranium alloy indicated the feasibility of obtaining a homogeneous alloy with good mechanical properties. (auth)

15896 NMI-2072

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for November 1958. Jan. 13, 1959. Decl. May 18, 1960. 20p. OTS.

The fabrication of U–2 wt.% Zr clad with Be by coextrusion is presented. A program to produce and evaluate Be which possesses a three-dimensional random texture even after hot working is described. Two methods are being tried to achieve this. Data are presented on the mechanical properties of Be rod made by upsetting and then extrusion. A program concerned with investigating an economical method of producing Th–U alloy fuel slugs by casting to size is reported. Zirconium and stainless steel have been dipped into molten U at 1150°C to determine the amount of attack on these metals by molten uranium. An attempt to bond a complete sandwich (V, U, Fe, U, Zr, U, Ti, U, and Nb) by heating to 750°C and slow cooling resulted in bonding some of the pieces into sandwiches. A detailed investigation of the $\frac{3}{2}$ U + MoO_3 = Mo + $\frac{3}{2}$ UO_2 reaction has been made. Work is continuing on the corrosion testing of Th alloys prepared by arc melting, including series of Th–Zr, Th–U, Th–Si, and a ternary series of Th–U–Zr. Samples of Y have been prepared for cold rolling, annealing and recrystallization. (W.L.H.)

15897 NMI-2073

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for December 1958. Feb. 10, 1959. Decl. May 18, 1960. 20p. OTS.

Beryllium Metallurgy. Tests on dimensional stability, resistance to cracking of the cladding, and deformation at elevated temperature were performed on coextruded, Be-clad, U–2% Zr alloy. By x-ray-diffraction techniques, a preliminary investigation was made of the phases present in cast Be–10 at.% Ge, Be–10 at.% Mn, and Be–10 at.% Cr alloys and extruded Be–0.15 at.% Y, Be–0.5 at.% Mn, Be–0.15 at.% Li, and Be–0.15 at.% Cd. Uranium Metallurgy. Castings were made of Th–U alloys in heated and unheated graphite molds, corrosion, metallographic and bond strength specimens of U–2 wt.% Zr clad with Zircaloy-2 have been prepared and are undergoing heat treatment. Thorium Metallurgy. Data are presented on the corrosion behavior of Th–Zr alloys in high temperature water. Zirconium Metallurgy. The twelve arc-melted Zr base alloys listed in previous reports have been hot rolled in the beta region at 1650°F. (W.L.H.)

15898 NMI-2076

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for March 1959. May 13, 1959. Decl. May 18, 1960. 52p. OTS.

Beryllium Metallurgy. The use of the bevatron for the radioactivation analysis of O_2 in Be is discussed. The cladding integrity and dimensional stability of Be-clad U fuel elements were investigated by thermal cycling. A rolling schedule to achieve random orientation in polycrystalline Be was selected. Hot-pressed, Be–rich Cu alloys were prepared for determination of their mechanical properties in uniaxial tension. Attempts are being made to fabricate dense samples of $ZrBe_{13}$, UBe_{13}, and (U, Zr) Be_{13} by extrusion. The alloy systems Be–Fe, Be–Co, and Be–Cu were investigated to determine the extent of the beta Be phase field, both in composition and in temperature Uranium Metallurgy. Texture studies were made on U rod extruded at 650°C; work on the slow extrusion at 485°C was continued, and a U billet containing 990 ppm silicon was cast in preparation for the study of textures resulting from the gamma extrusion. The evaluation of Th–5 to 15 wt.% U alloy slugs produced by arc melting and subsequent extrusion and induction melting and static casting of sized slugs is reported. The effect of interdiffusion heat treatment, and of subsequent heat treatments, upon the corrosion behavior of Zircaloy-2-clad U–2 wt.% Zr specimens containing 7-mil diameter defects extending into the core was studied. Thorium Metallurgy. Castings of Th–U, Th–U–Zr, and Th–Zr alloys were made. Zirconium Metallurgy. The corrosion testing of 12 ternary Zr-base alloys in 900 and 1000°F steam at 1500 psi is continuing. Other Problems. Some of the extrusion characteristics of canned Y were determined. The multi-temperature extrusion of stainless steel–clad UO_2, Mg–clad U, and stainless steel–clad U is reported. The extrusion of thin walled U alloy tubing is presented. (W.L.H.)

15899 NMI-2083

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for January 1960. May 6, 1960. 25p. Contract AT(30-1)-1565. OTS.

Investigation of U–UC systems was continued. Three additional melts were made and extruded. Data are included on the extrusion constants of some U–UC systems for comparison with that of beryllium. Thin specimens of ingot and dingot uranium, uranium–zirconium, molybdenum–uranium, and thorium were irradiated with 31.5 Mev alpha particles. The measured values of alpha particle depth penetration and the width of the He band are tabularly summarized. The stability of retained beta phase in Cr–U, and Cr–Nb–U alloys at 500°C was investigated. Results of x-ray examination of these alloys are tabulated together with results of previous work. Results of rapid quench on the retention of beta phase after heat treatment at 720°C in Cr–U–V, Fe–Si–U, Cr–Fe–Si, and Nb–U–V alloys are also given. The preparation and thermal analy-

sis of binary beryllium alloys were continued. Results of thermal analysis of Be–Pa, Be–Si, Be–Ag, and Be–Zr are discussed. Precipitation process in rod fabricated from beryllium powder was studied. Work on calibration of the tensile jig, beryllium single-crystal tensile sample electropolishing, and single-crystal production by vacuum-melting was continued. Studies to determine the isotopic interchange in dispersion-type fuel elements with depleted uranium matrix and enriched fuel were continued. Results so far indicate that diffusion in this system is negligible. A single crystal of UO_2 previously deformed by 0.2% compressive strain of 1500°C was analyzed for active deformation planes. The slip plane [111] was considered the most likely of the planes investigated. (For preceding period see NMI-2082.) (J.R.D.)

15900 NMI-2084

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for February 1960. May 20, 1960. 36p. Contract AT(30-1)-1565. OTS.

Extrusion cladding experiments involving U–UC core material clad with Be were initiated. Research on U–UC alloys of varying carbon content was continued. In glow-discharge experiments, vacuum fusion and mass spectrometry were used to determine the concentration of krypton gas introduced into metal specimens. Data from vacuum-fusion runs and mass spectrograph analysis are tabulated. A second cyclotron irradiation was performed on rolled ingot and dingot uranium and uranium–molybdenum alloys. Several post-irradiation treatments are outlined. Photomicrographs showing helium bubble bands in these specimens are included. Investigation of the stability of the retained beta phase in uranium-base alloys which were homogenized at 720°C for 24 hours is reported. Data on the phases present after treatment are included. Thermal analyses of binary beryllium alloys were continued. Included were tests on alloys of beryllium–palladium, beryllium–platinum, beryllium–vanadium, and beryllium–niobium. Elevated-temperature x-ray-diffraction studies of beryllium–nickel alloys were continued. Investigations of the kinetics of precipitation in rods fabricated from beryllium powder were continued. Results and tentative conclusions are included. Investigation of isotopic interchange in dispersion-type fuel elements was continued. Metallographic examination of a U–UC couple which had been heat treated at 975°C for 96 hours showed no evidence of the interaction. Metallographic examination of the surface of UO_2 crystals deformed in compression at 1000°C to a total strain of 2.8% showed possible deformation traces such as {1 1 1}, {1 1 0}, and {1 1 3} in addition to kinking. (For preceding period see NMI-2083.) (J.R.D.)

15901 NP-8684

Brigham Young Univ., Provo, Utah.

HIGH TEMPERATURE STUDIES. Final Report for June 19, 1956–March 31, 1960. H. Tracy Hall. 41p. DA Project No. 5B99-01-004. Contract DA-04-495-ORD-792.

An apparatus for subjecting up to 10 cc of material to pressures of 15,000 atm at temperatures as high as 10,000°C was developed and is described. The apparatus is relatively simple in design and could readily be scaled-up by a factor of 25 in volume, if desired. Temperatures of 10,000°C can usually be maintained for periods of 5 to 15 seconds, but in some instances have been maintained for as long as one minute. With this new apparatus, a survey of the effects of very high temperature was made on several carbide, boride, nitride, phosphide, oxide, sulfide, and some miscellaneous systems. One material produced under these high-temperature, moderate pressure conditions may have immediate practical use. This material is fused silicon carbide. The compressive strength of this material is 30 times as great as that of ordinary hot-pressed SiC. This high strength silicon carbide may be useful as a cutting tool material. Some of the oxide systems of chromium and manganese exhibited rather high compressive strengths following high temperature treatment. This was true also for ZrB_2 and TiB_2. Some of the metallic oxides produced under high temperature conditions formed semi-conducting materials and might be of further interest with respect to their electrical properties. Some systems were studied at 94,500 atm at relatively high temperatures in the Tetrahedral Anvil Apparatus. Two definite new materials were produced under these conditions. One of these is a face-centered cubic BP with a = 4.54 A. The other material is BS with a diamond cubic structure and a = 4.33 A. Results of microscopic and x-ray examination on many of the systems studied are given. (auth)

15902 NP-8775

Carborundum Co. Research and Development Div., Niagara Falls, N. Y.

DEVELOPMENT OF NON-OXIDIC REFRACTORY FOAMS. Final Report [for] February 16, 1959 through February 15, 1960. I. M. Logan, J. J. McGahan, C. von Doenhoff, and D. C. Wise. Apr. 1960. 48p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-6294.

Fundamental technology was developed for the preparation of non-oxidic refractory foams of controlled pore diameter, spacing, and continuity. Foaming procedures used in making commercially available foam plastics were employed to produce the resin-type foams which formed the basis for the final refractory foams. It was shown that foam structures can be varied as to strength, density, and pore size by varying the proportions of resins and solvents used to generate the foams. Lesser controls were also possible by varying the temperature and pressure during the foaming process. Good control and predictable results were obtained. Foams were prepared of the following materials: carbides of titanium, tungsten, molybdenum, tantalum, and niobium; borides of titanium and of zirconium; and silicides of tungsten and of molybdenum. (auth)

15903 ORNL-987(Del.)

Oak Ridge National Lab., Tenn.

METALLURGY DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1951. E. C. Miller and W. H. Bridges, eds. June 7, 1951. Decl. with deletions Oct. 27, 1959. 73p. Contract W-7405-eng-26. OTS.

The stability and corrosion resistance of thorium exposed to eutectic NaK were investigated. Satisfactory results on thorium tube or rod fabrication by means of extrusion were obtained. Rolling and swaging thorium presented no difficulty but drawing proved unsuccessful. Strain-hardening values of iodide thorium were about half of those of Ames thorium. The fabrication of uranium tubing by extrusion was successful in the alpha but not in the gamma range. By increasing the extrusion ratio, an increase in the strength of the [410] fiber texture with respect to that of the [010] component and an increase in sharpness of both resulted. Static corrosion tests using a two-component system was initiated. The characteristics of a plate which is to be fabricated into a fuel element tube were determined and methods for fabrication of such a plate are discussed. (See also ORNL-910(Del).) (C.J.G.)

15904 RISÖ-13

Denmark. Atomenergikommissionen. Forsögsinstitut, Risø.

SINTERED ALUMINIUM POWDER FOR REACTOR APPLICATIONS. Niels Hansen, Eivind Adolph, and Jørgen Christensen. May 1960. 48p.

Preliminary investigations on SAP (sintered aluminum powder) alloys are reported. The mechanical properties of SAP at elevated temperatures are only slightly altered by prolonged heating. Its structural stability is not effected by temperatures at 450°C and lower temperatures, blistering starts at 620°C and fissures appear in thin walled SAP 930 tubes at temperatures higher than 500°C. Thermal cyclings have no influence on the mechanical and structural stability of SAP 930 tubes. Vacuum tightness of SAP tubes can be maintained with temperatures up to 620°C. Pressure tightness for an internal pressure of 4 atm of helium is kept at 450°C. Thin-walled tubes with twisted fins are made of SAP 930. Joining of SAP parts by flash- and by braze-welding is satisfactory. End closures of the tubes are vacuum tight and show a mechanical strength equal to that of the parent material. SAP shows good corrosion resistance to polyphenyls at 400°C. There is no reaction between SAP and UO_2 after heating at 550°C for 56 days. Lead and SAP are highly compatible. Neutron irradiation of SAP raises the mechanical strength and lowers the elongation in the material, but the differences between unirradiated and irradiated properties do not appear to be important. (auth)

15905 RPL-43/2

Watertown Arsenal. Rodman Process Lab., Mass.

PROPOSED BASIS FOR TESTS OF CEMENTED CARBIDES. William O. Woods and Bennett Bovarnick. May 1959. 15p. (AD-228214). OTS.

Based on data compiled from information obtained from industrial producers and other carbide investigators, an examination was made of the hypothesis that a linear relation exists between hardness and strength of cemented carbide materials. The study incorporates mathematical and graphic representations of the percepts involved in the investigation. Data reported by Kieffer and Hotop were chosen as representative for the extended examination. (auth)

15906 SEP-167

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.

MAGNETIC DETERMINATION OF IMPURITIES IN URANIUM FUEL SLUGS. D. Wahl and A. Liboff. June 18, 1956. Decl. Mar. 30, 1960. 21p. Contract AT-30-1-GEN-366. OTS.

A technique has been devised for the non-destructive determination of the uranium hydride and/or iron content in uranium fuel slugs of Hanford size. The technique, an adaptation of the Gouy method for measuring magnetic susceptibilities, is based on the ferromagnetic properties of the hydride below 173°K. A large electromagnet and a pan balance are utilized in measuring the magnetic forces on a vertically suspended slug at liquid nitrogen temperatures and at room temperature. It was found possible to test as many as 250 slugs per eight-hour day in this manner. (auth)

15907 SEP-221

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.

A STUDY OF THE HYDRIDE PROCESS FOR PRODUCING THORIUM POWDER. R. H. Witt, J. Nylin, and H. M. McCullough. Aug. 12, 1956. Decl. Mar. 30, 1960. 30p. Project No. 1878. Contract AT-30-1-GEN-366. OTS.

This investigation was started to establish the best process for producing pure thorium powder using the hydride technique and thorium bars or Derby thorium as the raw materials. Early work showed that decomposition cycles previously reported were ineffective for production of powder having low residual hydrogen contents. Decomposition cycles are reported herein for the lower hydride, ThH_2 and the higher hydride, ThH_4. The significance of such factors as amount of charge, length of cycle, atmosphere, temperature and friability of sintercake was studied. Sample slugs were hot-pressed from typical powders and evaluated for chemical analysis, density, grain size, and hardness. Slugs with hydrogen contents above 440 ppm were significantly low in density and had significant variations in hardness. (auth)

15908 SEP-238

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.

METALLOGRAPHIC TECHNIQUES FOR BOND STUDY OF ALUMINUM-CLAD NICKEL-PLATED URANIUM FUEL ELEMENTS. H. W. Woods. Mar. 27, 1957. Decl. Mar. 30, 1960. 11p. Contract AT-30-1-GEN-366. OTS.

Various metallographic techniques were employed to determine the best method for the preparation of Al-clad, Ni-plated U fuel elements for bond studies. The quality of the final results and the speed of the preparation were the most important factors to be considered. The procedure presented was found to yield the most advantageous results in the minimum amount of time. (W.L.H.)

15909 TID-5747

Sylvania-Corning Nuclear Corp., Bayside, N. Y.

INFORMAL LETTER PROGRESS REPORT, MARCH 1960. [J. L. Zambrow. Apr. 19, 1960]. 14p. Contract AT-30-1-GEN-366. OTS.

Preparation and properties of UO_2 containing 5.6 mole % Y_2O_3 in solid solution are reported. Calibration of a low-temperature furnace was continued at higher temperature using UO_2 standard samples of 95% density. A sample of 4 mole % Y_2O_3 in UO_2 was heated without melting to 2650°C. It appears that such addition depresses the UO_2 melting point less than 100°C. A density of 85% of theoretical was obtained in a column of fused UO_2 powder by ultrasonic vibration. Further investigations are scheduled. Samples prepared for autoclave testing at 750°F and 1500 psi include as-received stainless tubing, stainless tubing with electron-beam-welded end caps, and pressed UO_2 core and stainless steel powder end caps. The procedure for preparing UO_2 irradiation test samples was proof-tested during the period. Data and photographs of yttrium–uranium alloys prepared for metallographic inspection and irradiation tests are included. (For preceding period see TID-5634.) (J.R.D.)

15910 TID-5937

Flow Corp., Arlington, Mass.

GROWTH OF METAL SINGLE CRYSTALS AND THE PRODUCTION OF HIGH PURITY METALS. I. PRINCIPLES, TECHNIQUES AND APPARATUS. R. S. Davis and D. W. Batteau. Dec. 1959. 41p. Contract AT(30-1)-2049. OTS.

Methods and apparatus required for growing high melting point metal single crystals and alloy single crystals of full solid solubility are discussed. The production of high-purity metals is discussed. (C.J.G.)

15911 WADC-TR-58-13(Pt. III)

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

HIGH-TEMPERATURE INSULATION FOR WIRE. Period

[covered] March 1959 to March 1960. J. N. Harris and J. D. Walton, Jr. Mar. 1960. 39p. Project title: ELECTRICAL AND ELECTRONIC MATERIALS. Task title: ELECTRICAL AND ELECTRONIC INORGANIC MATERIALS. Contract AF33(616)-3944. OTS.

Normal anodizing of commercial aluminum-clad copper wire did not result in complete anodization of the aluminum due to its thickness. Advantage was taken of the solvent action of sulfuric acid to remove a portion of the excess aluminum however, complete anodization was not possible due to uneven removal of the aluminum causing exposure of the copper. Best results obtained were an anodized coating thickness of 0.8 to 1.0 mils and an unanodized aluminum layer 0.3 mil in thickness. The use of electrophoretic deposition of colloidal silica for sealing the pores of anodized coatings was not successful. Better results were obtained by providing colloidal silica sealing by gelling hydrolyzed ethyl silicate solutions on phosphoric acid anodized wire. This resulted in a wire insulation with an average dielectric constant of 2.89 and a dissipation factor of 1.87 per cent. The best insulation system was provided by sealing sulfuric acid—magnesium chloride anodized wire with a frit-resin coating. This wire was capable of operating at 800°F. (auth)

15912 WADD-TR-59-13

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF THE PROPERTIES OF TANTALUM AND ITS ALLOYS. Period [covered] May 1, 1958 through December 31, 1959. Frank F. Schmidt, William D. Klopp, William M. Albrecht, Frank C. Holden, Horace R. Ogden, and Robert I. Jaffee. Feb. 12, 1960. 162p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF33(616)-5668. OTS.

The reactions of unalloyed tantalum with air, nitrogen, and oxygen were studied. Vacuum sintering of high-purity and high-impurity-content tantalum powders was investigated to determine the conditions required for purification. The effects of alloying on the oxidation behavior of tantalum were determined. Several alloying elements were found to be effective in reducing both scaling and contamination. Interstitials were studied for their effects on mechanical behavior at low and elevated temperatures. Screening studies were conducted on the effects of substitutional alloying on mechanical properties at room temperature and at 2200°F. References are included. (auth)

15913 WADC-TR-59-415

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

SUMMARY OF SECOND HIGH-TEMPERATURE INORGANIC REFRACTORY COATINGS WORKING GROUP MEETING. [Period] covered: October 1958 to June 1959. David Roller. June 15, 1959. 140p. Project title: FINISHES AND MATERIALS PRESERVATION. Task title: SURFACE TREATMENTS AND COATINGS. (AD-232536).

The proceedings of the second High-Temperature Inorganic Refractory Coatings Working Group meeting held jointly by the WADC Materials Laboratory and the Georgia Institute of Technology Engineering Experiment Station on 26–28 May 1959 in Dayton, Ohio, are summarized. Forty-three technical personnel representing thirty-nine organizations met to present informal technical discussions of their work on inorganic refractory coatings for use over approximately 2500°F and for an informal seminar on the subject. Each organization's presentation is described, and a summary of the seminar is given. A bibliography of recent reports on refractory coatings and related subjects is included. (auth)

15914 AEC-tr-4081

RESULTS AND OUTLOOK OF SCIENTIFIC ACTIVITIES OF THE INSTITUTE OF THE PHYSICS OF METALS. M. N. Mikheev. Translated from Trudy Inst. Fiz. Metal., Akad. Nauk S.S.S.R., Ural. Filial No. 20, 5-11(1958). 11p. JCL or LC.

A review of activities and future program plans for the Institute of the Physics of Metals is presented. The main task of this organization is theoretical and experimental studies of the physical phenomena in metals and alloys which underline the present-day technical utilization of these materials and their future uses. (J.R.D.)

15915 NP-tr-432

ON THE MECHANISM OF FLUIDISATION OF SOLID-GAS SYSTEMS. [S.] Bracale and [A.] Cabella. Translated by R. S. Pease from Ricerca sci. 27, 1448-55(1957). 16p. (Handwritten MS. copy). JCL.

A study of particle bed fluidization was conducted with the emphasis on energy input. Homogeneous and non-homogeneous fluidized systems are considered. It is concluded that the energy supplied externally to a fluidized system is dissipated internally; however, for non-homogeneous fluidized beds it is very difficult to evaluate the total energy supplied to the system with respect to a particular fluidizing flow rate. (J.R.D.)

15916

TANTALUM AND NIOBIUM. G. L. Miller. Metallurgy of the Rarer Metals. 6. New York, Academic Press, Inc., 1959. 785p. $21.00.

A compilation is given of available chemical and metallurgical information on niobium and tantalum. Chemical processing is described from the decomposition of the ores to the separation and purification of the metals; from the Marignac process to modern liquid-liquid techniques. Academic and industrial processes are discussed for the production of these metals and their alloys. The consolidation of the metals is described from the earliest sintering processes to the latest arc-melting and electron bombardment techniques. The corrosion, mechanical, and physical properties of the metals are discussed. Applications of the metals, alloys, and compounds are given; including such important uses as tantalum for electrolytic capacitors, tantalum carbide for hard metals, and niobium for high temperature and nuclear applications. (B.O.G.)

15917

BERYLLIUM. G. E. Darwin and J. H. Buddery. Metallurgy of the Rarer Metals. 7. New York, Academic Press Inc., 1960. 400p. $13.50.

A complete and extensive collection of information on beryllium is presented. Among the topics included are beryllium's production and fabrication, metallurgy, physical and mechanical properties, chemistry, alloys and compounds, nuclear properties (cross sections and radiation effects), and health hazards. Two chapters on beryllium oxides and an appendix on methods for the determination of oxygen in beryllium are also given. (D.L.C.)

15918

REFRACTORY METALS. Robert I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). p.61-75 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of properties and uses of refractory metals, defined as those with melting points equal to or higher than that of chromium, is presented. Availability of these materials is discussed along with production, fabrication, and

properties. The mechanical properties and uses of refractory metal alloys are also examined as well as oxidation and corrosion protection. (J.R.D.)

15919

GRAPHITE, CARBIDE, NITRIDE AND SULFIDE REFRACTORIES. Lawrence M. Litz (National Carbon Co., Cleveland). p.90-112 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A discussion of carbon and graphite and the refractory carbides, nitrides, and sulfides is presented. Sources of carbon are examined along with fabrication and uses of graphitic bodies, effects of fabrication, and chemical properties of graphite. Preparation of the carbides, nitrides, and sulfides are outlined, and data on thermodynamic and other properties are given. (J.R.D.)

15920

SILICIDES, BORIDES, ALUMINIDES, INTERMETALLICS AND OTHER UNIQUE REFRACTORIES. J. H. Westbrook (General Electric Research Lab., Schenectady, N. Y.). p.113-28 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Results of an examination of the closely related boride and silicide families, the somewhat analogous phosphide group, and the broad class of intermetallic compounds, whose prime representative from the high-temperature viewpoint is the aluminide group, are presented. (J.R.D.)

15921

PYROMETALLURGY. H. H. Kellogg (Columbia Univ., New York). p.182-91 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of pyrometallurgy and associated processes is presented. Included are discussions of the advantages of pyrometallurgical processes and recent trends in this field. Applications of pyrometallurgy in reactions such as reductions with sodium and magnesium are discussed, and other extraction processes including electrowinning from fused salts, lead and zinc recovery, flash smelting sulfide concentrate, and fluid bed and direct iron processes are examined. Refining processes such as vacuum melting, electron bombardment melting, zone and gas phase refining, steel making, and reprocessing nuclear fuels are reviewed. (J.R.D.)

15922

HIGH TEMPERATURE RESEARCH IN THE UNITED KINGDOM. J. White (Univ. of Sheffield, Eng.). p.241-52 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Research and development on the mechanism of sintering, techniques of oxide sintering, non-oxide ceramics, cermets, and furnace refractories are outlined. (J.R.D.)

15923

RECENT FRENCH CONTRIBUTIONS TO HIGH TEMPERATURE RESEARCH. F. Trombe and M. Foex (Centre National de la Richerche Scientifique, Mont Louis, France). p.253-71 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A resumé of French research and development activities conducted from 1954 to 1959 is presented. Included are descriptions of research on production of high temperatures, measuring and regulating temperatures, refractory metals, metallurgical reactions, reactions of oxides at high temperatures, non-oxygen compounds, molten salts, properties of gases at high temperatures, and combustion. 262 references. (J.R.D.)

15924

HIGH TEMPERATURE RESEARCH IN JAPAN. Hisao Mii (Government Industrial Research Inst., Nagoya, Japan). p.277-91 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Research and development on the solar furnace are described. The initial solar furnace in Japan is described, and design of the second such furnace is presented. Other high-temperature research on structure of molten carbon, properties of carborundum, and UO_2–ThO_2 nuclear fuel systems is also discussed. (J.R.D.)

15925

ON THE HIGH TEMPERATURE RESEARCH IN SCANDINAVIA (IN THE RANGE 500-2000°C.). H. Flood (Norwegian Inst. of Tech., Trondheim, Norway). p.292-300 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of research and production facilities in these countries is presented. Research and development activities in metallurgy, nonmetallic solids, ceramics and refractories, salt-like compounds, and glass and melts of high polymeric acids are also outlined. (J.R.D.)

15926

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. William Bateman Hall (to United Kingdom Atomic Energy Authority). British Patent 835,132. May 18, 1960.

A fuel element design is described. A uranium carbide rod 1.6-in. diam. is enclosed by a 2-in. i.d. graphite tube which is sheathed in Be or Nb. Heat from the fuel radiates across the space to the graphite and is conducted away by sheath and coolant. (T.R.H.)

15927

MOLTEN FLUORIDE NUCLEAR REACTOR FUEL. C. J. Barton and W. R. Grimes (to U. S. Atomic Energy Commission). U. S. Patent 2,920,024. Jan. 5, 1960.

Molten-salt reactor fuel compositions consisting of mixtures of fluoride salts are reported. In its broadest form, the composition contains an alkali fluoride such as sodium fluoride, zirconium tetrafluoride, and a uranium fluoride, the latter being the tetrafluoride or trifluoride or a mixture of the two. An outstanding property of these fuel compositions is a high coefficient of thermal expansion which provides a negative temperature coefficient of reactivity in reactors in which they are used.

15928

NICKEL-BASE ALLOY. H. Inouye, W. D. Manly, and T. K. Roche (to U. S. Atomic Energy Commission). U. S. Patent 2,921,850. Jan. 19, 1960.

A nickel-base alloy was developed which is particularly useful for the containment of molten fluoride salts in reactors. The alloy is resistant to both salt corrosion and oxidation and may be used at temperatures as high as 1800°F. Basically, the alloy consists of 15 to 22 wt.% molybdenum, a small amount of carbon, and 6 to 8 wt.% chromium, the balance being nickel. Up to 4 wt.% of

tungsten, tantalum, vanadium, or niobium may be added to strengthen the alloy.

15929

TERNARY ALLOY-CONTAINING PLUTONIUM. J. T. Waber (to U. S. Atomic Energy Commission). U. S. Patent 2,926,083. Feb. 23, 1960.

Ternary alloys of uranium and plutonium containing as the third element either molybdenum or zirconium are reported. Such alloys are particularly useful as reactor fuels in fast breeder reactors. The alloy contains from 2 to 25 at.% of molybdenum or zirconium, the balance being a combination of uranium and plutonium in the ratio of from 1 to 9 atoms of uranium for each atom of plutonium. These alloys are prepared by melting the constituent elements, treating them at an elevated temperature for homogenization, and cooling them to room temperature, the rate of cooling varying with the composition and the desired phase structure. The preferred embodiment contains 12 to 25 at.% of molybdenum and is treated by quenching to obtain a body centered cubic crystal structure. The most important advantage of these alloys over prior binary alloys of both plutonium and uranium is the lack of cracking during casting and their ready machinability.

15930

METHOD OF FORMING A PROTECTIVE COATING ON FERROUS METAL SURFACES. D. G. Schweitzer, J. R. Weeks, O. F. Kammerer, and D. H. Gurinsky (to U. S. Atomic Energy Commission). U. S. Patent 2,926,111. Feb. 23, 1960.

A method is described of protecting ferrous metal surfaces from corrosive attack by liquid metals, such as liquid bismuth or lead–bismuth alloys. The nitrogen content of the ferrous metal surface is first reduced by reacting the metal surface with a metal which forms a stable nitride. Thereafter, the surface is contacted with liquid metal containing at least 2 ppm zirconium at a temperature in the range of 550 to 1100°C to form an adherent zirconium carbide layer on the ferrous surface.

15931

HEAT TREATED U–Mo ALLOY. R. K. McGeary and W. M. Justusson (to U. S. Atomic Energy Commission). U. S. Patent 2,926,113. Feb. 23, 1960.

A reactor fuel element comprising a gamma-phase alloy consisting of 11 to 16 wt.% of molybdenum and the balance uranium, annealed between 350 and 525°C and quenched to preserve the gamma phase, is reported.

15932

JACKETED URANIUM NUCLEAR REACTOR FUEL ELEMENT. W. R. Huey (to U. S. Atomic Energy Commission). U. S. Patent 2,927,071. Mar. 1, 1960.

A uranium rod encased by two aluminum cans internested together from opposite directions along their full lengths and with all interfaces bonded together by an aluminum–silicon alloy was developed.

15933

DELTA PHASE PLUTONIUM ALLOYS. E. M. Cramer, F. H. Ellinger, and C. C. Land (to U. S. Atomic Energy Commission). U. S. Patent 2,929,706. Mar. 22, 1960.

Delta-phase plutonium alloys were developed suitable for use as reactor fuels. The alloys consist of from 1 to 4 at.% zinc and the balance plutonium. The alloys have good neutronic, corrosion, and fabrication characteristics and possess good dimensional characteristics throughout an operating temperature range from 300 to 490°C.

15934

METHOD FOR COATING GRAPHITE WITH METALLIC CARBIDES. M. A. Steinberg (to U. S. Atomic Energy Commission). U. S. Patent 2,929,741. Mar. 22, 1960.

A method for producing refractory coatings of metallic carbides on graphite was developed. In particular, the graphite piece to be coated is immersed in a molten solution of 4 to 5% by weight of zirconium, titanium, or niobium dissolved in tin. The solution is heated in an argon atmosphere to above 1400°C, whereby the refractory metal reacts with the surface of the graphite to form a layer of metallic carbide. The molten solution is cooled to 300 to 400°C, and the graphite piece is removed. Excess tin is wiped from the graphite, which is then heated in vacuum to above 2300°C. The tin vaporizes from the graphite surface, leaving the surface coated with a tenacious layer of refractory metallic carbide.

Corrosion

15935 AERE-C/R-2610

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AUTOCLAVE STUDIES ON HOMOGENEOUS AQUEOUS REACTOR SOLUTIONS IN PILE. R. S. Tilbury. June 1958. 20p. (HARD(C)/P-50).

Experiments are described to establish the conditions for stability of Homogeneous Aqueous Reactor solution in small stainless steel autoclaves at 300°C. Studies were made first out-of-pile and then in B.E.P.O. Measurements of the corrosion rate of stainless steel were also made under these conditions. (auth)

15936 CDRA-196

Tréfileries et Laminoirs du Havre. Centre de Recherches. Antony, France.

TENUE A LA CORROSION PAR L'EAU A HAUTE TEMPERATURE DE L'ALLIAGE Al–Fe–Ni–APRES DES CHAUFFAGES DE LONGUE DUREE. INFLUENCE DES ADDITIONS Ti ET Zr. (Corrosion Behavior of Al–Fe–Ni Alloy in Water at High Temperature After an Extended Heat Treatment. Effects of Ti and Zr Additions). P. Lelong, J. Moisan, and J. Hérenguel. Sept. 10, 1959. 25p.

A study was made of the corrosion of 1% Ni–1% Fe–Al with trace additions of Ti and Zr by water at 350°C for 10 hr. These alloys undergo a noticeable coalescence in these conditions with a progressively diminishing corrosion resistance. Intergranular corrosion, suppressed by the Ni, reappears. The Ti and Zr additions effectively prevent the effects of prolonged exposure. The Zr enters into the complex intermetallic compounds and modifies the corrosion mechanism. (T.R.H.)

15937 CF-60-3-156

Oak Ridge National Lab., Tenn.

CORROSION PROTECTION OF STAINLESS STEEL PIPING BY TITANIUM INSERTS: EXAMINATION OF TITANIUM INSERTS REMOVED FROM LOOP N AFTER RUN N-24. R. S. Greeley. Mar. 31, 1960. 6p. OTS.

The use of titanium inserts to protect type 347 stainless steel in turbulent areas of pump loops in which uranyl sulfate solutions are circulated was shown to be possible. In the case of a dead-ended crevice, reduced uranium and magnetite were found indicating the absence of oxygen, but no serious attack of either titanium or stainless steel was observed; there was, however, an indication that a slight amount of hydrogen was absorbed by the titanium. In a crevice having freer access to oxygen, neither reduced uranium nor magnetite was found, and there was no evidence of hydriding of the titanium. (auth)

15938 CF-60-4-97
Oak Ridge National Lab., Tenn.
CORROSION IN THE OAK RIDGE RESEARCH REACTOR CORE-COOLING SYSTEM. P. D. Neumann. Apr. 25, 1960. 17p. OTS.

Corrosion specimens of the five major aluminum alloys used in the construction of the Oak Ridge Research Reactor have been exposed to the high-purity primary cooling water in the ORR core and in the external portion of the primary cooling loop to determine their corrosion rates under actual operating conditions. These alloys, 1100, 3003, 5052, 5154, and 6061, exhibited average corrosion rates of less than 2.6 mpy during the first 500-hr test period and less than 0.5 mpy for a 4032-hr test. Very superficial pitting was observed, and no case of intergranular corrosion was found. (auth)

15939 CRMet-882
Atomic Energy of Canada Ltd., Chalk River, Ont.
CORROSION BEHAVIOUR OF 10197 ALUMINUM–NICKEL–IRON ALLOY IN HIGH-TEMPERATURE WATER UNDER DYNAMIC CONDITIONS. G. J. Biefer and J. R. Keenan. Apr. 1960. 44p. (AECL-1006). AECL.

Under optimum conditions specimens of 10197 aluminum alloy (2 wt.% Ni, ½ wt.% Fe, 0.2 wt.% Si, 0.2 wt.% Ti, 0.05 wt.% Be, 0.05 wt.% Zr) corroded at about 5×10^{-3} inches/year in deionized water at 260°C and 20 ft/sec linear velocity. Corrosion was considerably reduced for specimens given a prefilming in static water at 300°C prior to the dynamic test, but no reduction in corrosion rate resulted from techniques aimed at increasing the concentration of dissolved aluminum oxide in the loop water. The measurements confirmed previous observations that dynamic rates are dependent on the area of aluminum alloy in the loop, and upon the location of the specimens. In different regions of the loop, simultaneous corrosion rates were observed which differed by a factor of approximately 10. It was also shown that the corrosion rate was time-dependent; specimens added at intermediate stages of a test showed higher initial corrosion rates than the original specimens. For the particular loop used, it was further demonstrated that the dynamic rate had increased steadily over a 1500 hour period, eventually arriving at a stable condition in which the corrosion rate was the 5×10^{-3} inches/year cited above. It was not found possible to explain these phenomena satisfactorily, though it appears that they must be due to changes in water composition. (auth)

15940 GEAP-3333
General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.].
CORROSION OF BERYLLIUM IN FLOWING SODIUM. W. W. Kendall. Jan. 15, 1960. 30p. Contract AT(04-3)-189. OTS.

Samples of seven types of fabricated beryllium were exposed to sodium flowing at 20 ft/sec at 900°F for 47 hours followed by 520 hours at 1000°F. The oxide content of the sodium was first reduced by cold-trapping and then gettering with about 1% calcium. On completion of the test, all samples were found to be nitrided and some were joined together at points where the beryllium had been in contact with beryllium. Variation in behavior between the different samples was not apparent. The Be_3N_2 film was the thickest (~50 microns) on the face exposed to high velocity sodium. The Be_3N_2 film was black, hard, and adherent. The beryllium below the surface film did not appear to be affected by exposure to sodium. (auth)

15941 KAPL-2071
Knolls Atomic Power Lab., Schenectady, N. Y.
EFFECT OF HEAT-TREATMENT ON THE CORROSION OF ZIRCONIUM–2 At. % TIN–2 At. % NIOBIUM. D. L. Douglass and B. E. Dearing. Jan. 20, 1960. 16p. Contract W-31-109-Eng-52. OTS.

The effect of various heat treatments on the corrosion behavior of zirconium–2 At. % tin–2 at. % niobium was studied in 680°F water and 750°F steam, with test times varying up to 112 days. The best corrosion behavior was observed on samples which had been annealed for 24 hr at 800°C or which had been cold-rolled 30% after hot-rolling at 750°C. Quenching from 950°C resulted in higher weight gains during corrosion tests than any other heat-treatment; tempering of the quenched structure at 600°C for 100 hr improved the corrosion behavior. No simple rate law was applicable to the kinetics of corrosion. Changes in the rate law exponent from <0.5 to 1 (values approximating linear kinetics) after longer exposures could not be attributed to rupturing, porosity, or break-away of the film. Basic differences in corrosion resistance between annealed or slowly cooled and quenched samples were attributed to different metal textures and the resultant different epitaxial relationship of oxide to metal. The best corrosion resistance was observed for a (0001) alloy texture with the (111) ZrO_2 planes nearly parallel to the basal planes of the metal. Quenched samples possessed a $(11\bar{2}0)$ texture with an approximate (001) oxide texture. Oxygen and hydrogen pickup was analyzed and found to be negligible. (auth)

15942 KAPL-2079
Knolls Atomic Power Lab., Schenectady, N. Y.
CORROSION OF THE ZIRCALOY-2–NIOBIUM COUPLE. R. E. Campagnoni and M. A. Powers. Mar. 14, 1960. 20p. Contract W-31-109-Eng-52. OTS.

An investigation was made to determine if galvanic corrosion on a Zircaloy-2–niobium couple exists under reactor conditions. The amount of damage that might occur for such a situation was estimated. Mechanically coupled and uncoupled specimens of Zircaloy-2 and niobium were exposed for 49 days to 680°F static water to which LiOH was added to obtain a pH of 9.5 ± 0.5. The specimens were so coupled to provide varying surface ratios of Zircaloy-2 to niobium. Weight change measurements on each specimen were made after 4, 9, 16, 25, 36, and 49 days. The weight changes of the Zircaloy-2 were a function of time and coupling; its coupling effects were a maximum of 10%, and its weight change rate was continually decreasing. The niobium weight changes were a function of time, coupling, and autoclave. The effect of coupling was a maximum of 30%, and the weight change-time relationship was complex, with first an increasing rate, then decreasing, then increasing again. Since a high resistance existed between the elements of a couple after the first exposure period, the coupling effects were apparently not galvanic, but it is proposed that they are probably due to the mechanical disconnecting of the couples for weighing. (auth)

15943 NMI-TJ-23
Nuclear Metals, Inc., Concord, Mass.
AQUEOUS CORROSION OF ZIRCALOY-CLAD FUEL ELEMENTS WITH HIGH URANIUM CORES. S. Isserow and R. G. Jenkins. Sept. 20, 1959. 36p. OTS.

Presented at Brussels Conference on the Aqueous Corrosion of Reactor Materials.

Corrosion behavior is a prime consideration in the design of a fuel element to be used in a water-cooled nuclear reactor. Despite their inherently poor corrosion resistance, economically attractive natural uranium or its high alloys can be made into satisfactory fuel elements by use of a sound protective cladding. For U–2

wt. % Zr alloys, the protection offered by the cladding has been increased by the use of a diffusion heat treatment. Despite such protective measures, however, allowance must be made for the occurrence of cladding flaws which would permit exposure of the core material and consequent corrosion, leading to destruction of the fuel element. Various techniques have been used to study the corrosion of fuel elements with artificial cladding defects in water at temperatures up to 349°C (660°F). These studies have indicated that even in 349°C (660°F) water, the corrosion of certain defected fuel elements is slow enough to permit detection in time for a safe reactor shut down. Such fuel element failure is not expected to be disastrous in terms either of uranium release or of physical damage to the fuel element. Reactors can be designed with appropriate detection systems to permit exploitation of the other advantages of high-uranium metallic fuel elements without concern for the consequences of exposure of the core to water. (auth)

15944

CORROSION OF SOME METALS AND ALLOYS IN URANIUM HEXAFLUORIDE. D. Heymann and F. E. T. Kelling (Materials Research Foundation, Amsterdam). Corrosion Technol. 5, 148-51(1958) May.

Uranium hexafluoride was used to study the nature of the fluoride attack on metals and alloys. Samples of aluminum, steels, copper alloys, nickel alloys, and titanium alloys were placed in containers with UF_6 and immersed in an oil bath 80 ± 0.5°C and 2.4 atm. In the majority of experiments the corrosion was accompanied by formation of crystals on the surface. The crusts were heavier when fluorine penetration was greater. X-ray analyses indicated that the larger part of the deposits was UF_4. It may be stated that part of the crystals on the steels were ferric fluorides. The excellent properties of nickel, Monel, copper, and aluminum in resisting the fluoride attacks have been proven. The resistances of steels are highly satisfactory; stainless steels with high nickel content are excellent; and titanium alloys are good. (B.O.G.)

15945

CORROSION OF UNALLOYED URANIUM BY WATER INCLUDING A CONSIDERATION OF PROTECTIVE COATINGS. B. E. Hopkinson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Corrosion Technol. 6, 337-40(1959) Nov.

A summary of available information on the corrosion of unalloyed U by water is given. Conditions range from 35 to 350°C. The effects on corrosion of various factors are reviewed, e.g., dissolved impurities (D_2, inert gas, H_2O_2, Cl^- and OH^- anions) and heat treatment of U. Protective coatings are also considered. No satisfactory coating or treatment was found which will enable unalloyed U to withstand immersion in hot water for long periods. (D.L.C.)

15946

DEVELOPMENT AND USE OF A PROBE FOR STUDYING CORROSION IN SUPERHEATERS AND REHEATERS. J. G. Koopman and E. M. Marselli (Electric Energy, Inc., Joppa, Ill.); James Jonakin (Combustion Engineering, Inc., Chattanooga) and R. C. Ulmer (Combustion Engineering, Inc., New York). p.236-45 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

A probe has been developed to study the corrosion of superheaters and reheaters under actual operating conditions. Wastage of Type 321 stainless steel within practical temperature limits was found to be associated with ash constituents having low melting temperatures. Maximum metal loss for this alloy occurred at 1050 to 1150°F, whereas the wastage was very little at 1300°F and higher. Under test conditions, the corrosion of Types T-11 and T-22 appears to be in the gas-phase oxidation. Coal selectivity and its grinding to a finer size are possible methods for the reduction of corrosion in these areas of boilers. (B.O.G.)

Fabrication

15947 AD-226535

Aeroprojects, Inc., West Chester, Penna.

FUNDAMENTALS OF ULTRASONIC WELDING. PHASE II. Bimonthly Progress Report No. 3 [for] April 16 to June 15, 1959. 38p. Contract NOas 59-6070-c.

Photoelastic analysis of the internal transient stress patterns associated with ultrasonic welding has continued. The normal, shear, and transverse stress values are all higher at the tip-work interface than at the weld interface, but, in the latter zone, both their inter-relation and their distribution are markedly different from those in the tip locale. The theory and application of photoelastic techniques to the problem under consideration are reviewed. Further information concerning electrical power, acoustical power, and acoustical energy per unit weld area for several additional materials and gages is presented. Additional evidence relating the transient interfacial stress distribution to the zone of interfacial disturbance and metal displacement is included. (auth)

15948 AD-227967

Brush Beryllium Co., Cleveland.

FABRICATION OF BERYLLIUM WIRE. Progress Report No. 4 for April 16 to July 1, 1959. Technical Report No. 155. A. G. Gross, Jr., R. G. O'Rourke, and W. W. Beaver. 59p. Contract NOas-59-60-30-C.

Operational drawing parameters were established for 12.5° tungsten carbide dies, using molybdenum disulfide with an epoxy resin binder for lubrication. Beryllium wire of 0.063-inch diameter was drawn successfully with this technique. X-ray-diffraction studies indicated that perfect texture will not result from any real values of drawing reduction regardless of annealing practice. These studies indicated that the operative slip systems are basal and the average fiber axis is [210]. Annealing practices were investigated, and two feasible cycles were found. A temperature of 1290°F for 60 minutes with an air cool may be used for a reasonably efficient stress relief without recrystallization. A temperature of 1480°F for 30 minutes with heat shield followed by air cooling may be used to completely stress relieve with recrystallization. Heating rate appears to be a critical parameter in this practice. The 1480°F temperature is preferred from the standpoint of uniformity of annealed tensile properties. The production of draw stock by swaging powder, sintering, and warm swaging the sintered rod was probed and promising results were obtained. (auth)

15949 BMI-1436

Battelle Memorial Inst., Columbus, Ohio.

FURTHER DEVELOPMENT OF GAS-PRESSURE BONDING OF ZIRCALOY-CLAD FLAT-PLATE URANIUM DIOXIDE FUEL ELEMENTS. Stan J. Paprocki, Edwin S. Hodge, Edwin H. Layer, Edwin G. Wintucky, Paul J. Gripshover, and Donald C. Carmichael. May 11, 1960. 59p. Contract W-7405-eng-92. OTS.

The effects of core barrier coatings, void spaces, and surface-cleaning techniques on the quality of Zircaloy-clad flat-plate UO_2 fuel elements prepared by gas-pressure bonding were investigated. Techniques were developed for the application of barrier layers of chromium by a vapor-deposition process and of crystalline carbon by a pyrolytic process. These coatings, together with a graphite coating previously developed, were evaluated in pressure-bonded fuel elements for their effectiveness in preventing core-to-cladding reaction and for their general production feasibility. Crystalline carbon coatings 15 to 40 μin. thick and chromium coatings 25 to 40 μin. thick were determined to be satisfactory. In the study of the flow of cladding-plate material into void spaces in the picture-frame assembly, it was established that excessive flow, and consequent thinning of the cladding, can be minimized by individually compartmentalizing the cores with Zircaloy ribs. This design resulted in maximum restriction of the effects of a cladding failure in service. Quantitative data on the maximum amount of void space resulting from manufacturing tolerances or from chipped fuel cores that is tolerable in elements of this design were obtained. In studies of surface-cleaning techniques, it was found that a final multistep rinsing cycle resulted in bonds consistently free of evidence of contamination. (See also BMI-1374.) (auth)

15950 CNLM-1802-14

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

FABRICATION OF BERYLLIUM: A BIBLIOGRAPHY. Elizabeth A. Cernak, comp. Apr. 1, 1960. 28p. OTS.

A bibliography containing 147 references on the fabrication of beryllium is presented. References are given on the brazing, casting, cladding, extrusion, and welding of beryllium and beryllium-rich alloys. The bibliography is limited to the period 1950 to 1959. Sources are listed. (J.R.D.)

15951 HW-36169

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HOT PRESS CANNING OF THORIUM. C. H. Bloomster. Mar. 24, 1955. Decl. Mar. 16, 1960. 8p. Contract [W-31-109-Eng-52]. OTS.

A process for hot-press canning of unplated Th cores in Al jackets was developed using wafers of Th and Al for diffusion and bonding studies. Thorium wafers which were electroplated with Ni, Cu, or Fe–Ni and hot-pressed canned appeared to offer no advantages in uniformity of diffusion or bond strength (the bases of the evaluation) over unplated thorium. Canning operations with full size unplated cores resulted in over half the canned assemblies being rejected because of unbonding between the core and jacket. Experiments which were run to determine the cause of the unbonding indicated that it was due to materials occluded in the Th core (apparently during fabrication) which volatilized during the canning operation. (auth)

15952 HW-36763

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A STUDY OF THE FABRICATION FAILURES FOR ZIRCONIUM AND ZIRCALOY-2 PROCESS TUBES AND OF THE ANNEALING AND COLD ROLLING OF ZIRCALOY-2. Dale E. Johnson. May 19, 1955. Decl. Mar. 16, 1960. 28p. OTS.

A study of the fabrication failures for zirconium and Zircaloy-2 process tubes was made. In the tube reducing operation, a non-uniform reduction in area for the cross section was found to be a major cause of failure. In annealing studies, a cycle of 2 hours at 820°C in vacuum followed by furnace cooling produced the greatest ductility of extruded Zircaloy-2 for the annealing treatments studied. The ductility of cold worked and annealed Zircaloy-2 was found to be superior to that of extruded and annealed material. The strain rate of a cold working process was found to affect the ductility of Zircaloy-2. (C.J.G.)

15953 KAPL-M-JMG-13

Knolls Atomic Power Lab., Schenectady, N. Y.

FABRICATION OF BOX SECTION TYPE FLOW TEST ASSEMBLIES BY WELDING. J. M. Gerken and S. A. Toftegaard. Mar. 23, 1960. 15p. OTS.

Heat transfer tests on heater units having some of the features of fuel elements require that these heater units be fabricated by welding. The possible methods by which the heater assemblies could be welded were investigated. Two methods were tried; resistance seam and roll spot welding, and tungsten inert gas seam and spot welding. (W.D.M.)

15954 NMI-1229

Nuclear Metals, Inc., Concord, Mass.

MULTI-TEMPERATURE EXTRUSIONS. E. S. Guidoboni, I. B. Roll, and P. Loewenstein. Mar. 14, 1960. 49p. Contract AT(30-1)-1565. OTS.

Multi-temperature techniques for achieving uniform plastic flow during extrusion of a composite billet were investigated. Efforts to produce successful coextrusions of uranium clad with stainless steel and magnesium, and of uranium dioxide clad with stainless steel and molybdenum are described. (auth)

15955 NMI-2508

Nuclear Metals, Inc., Concord, Mass.

THE FABRICATION OF CLAD MASSIVE UO_2 FUEL ELEMENTS BY COEXTRUSION. Third Quarterly Report. J. G. Hunt and P. Loewenstein. Apr. 20, 1960. 26p. Contract AT(30-1)-1565. OTS.

Six rods of uranium oxide were extruded at high temperature to produce high-density oxide of desirable stoichiometry. Four extrusions were produced from 1.5-inch billet cores, two at reductions of 12×, and two at reductions of about 20×. Two other extrusions were performed directly in stainless steel from 0.875-in. billet cores at reductions of 12× without an inner sheath of graphite or tantalum. The central problem now appears to be the roughness between the core and clad. Desirable results probably will be obtained if the stainless component is kept as stiff as in the tantalum extrusion and the core as hot as in the insulated extrusion. (For preceding period see NMI-2505.) (J.R.D.)

15956 NMI-FR-15

Nuclear Metals, Inc., Cambridge, Mass.

FEASIBILITY REPORT FOR THE FABRICATION OF PROTOTYPE ZIRCALOY-CLAD URANIUM FUEL ROD FOR HANFORD ATOMIC PRODUCTS OPERATION. H. F. Sawyer. Jan. 28, 1958. 35p. OTS.

It is proposed to fabricate by coextrusion 100 feet of rod for HAPO containing unalloyed 1.6% enriched U. The rod is to be clad with 0.030 inch of Zircaloy-2 and have a diameter of 0.630 inch. The fabrication cycle comprises the following major operations: canning and evacuation, extrusion, pickling, swaging, and packaging and shipping. Criticality safeguards, health and safety, accountability, and security are detailed. (W.D.M.)

15957 NOR-60-92

Northrop Aircraft, Inc., Hawthorne, Calif.

PROGRAM FOR THE DEVELOPMENT OF EXTRUDED

BERYLLIUM SHAPES. Interim Engineering Report No. 7 [for] December 1, 1959 through February 29, 1960. 24p. Contract AF33(600)-36931.

A portion of the total effort of the Beryllium Extrusion Development Program, Phase I is reported. The work reported herein is part of an extension to Phase I in which the major problems of beryllium extrusion are being thoroughly investigated. Feasibility of unclad beryllium extrusion was demonstrated in Phase I proper, but additional work was considered necessary to perfect extrusion methods. Twenty linear foot lengths of extruded shapes are desired; five to six foot shapes were made in Phase I proper; ten to twelve foot lengths have now been realized; and efforts are now being directed toward method development for the twenty-foot long Phase I channel shaped extrusions. Efforts now being expended should reduce the scope of tasks required to successfully complete Phases II and III. (auth)

15958 NP-8705

Aeroprojects, Inc., West Chester, Penna.

ULTRASONIC WELDING SURVEY REPORT AND ULTRASONIC WELDING EQUIPMENT MANUAL. Period covered: December 1, 1957—December 1, 1958. Research Report No. 59-106. W. C. Potthoff and H. L. McKaig. May 1959. 25p. Contract NOas-58-108-c.

Results are presented of a survey of the aircraft, missile, and electronics industries to determine the areas in which ultrasonic welding techniques may be most useful, and the way in which ultrasonic equipment developments should be channeled to realize maximum benefits. Defense Department suppliers representing a cross section of present and future ultrasonic equipment users were contacted. Also included are a general description of ultrasonic equipment, and an estimate of weld reliability. (J.R.D.)

15959

HEAT-TREATMENT OF URANIUM. G. Ya. Sergeev, V. V. Titova, Z. P. Nikolaeva, and A. M. Kaptel'tsev. Atomnaya Energ. 8, 340-7(1960) Apr. (In Russian)

A method for improving the stability of uranium by β and γ phase annealing and the effects of annealing on chemical composition of the micro- and macro-grain structure are discussed. The creep of uranium in the α-phase temperature range is also analyzed. (tr-auth)

15960

STRESSES IN CYLINDRICAL VESSELS DUE TO LOCAL HEATING STRESS RELIEF OF CIRCUMFERENTIAL WELDS. R. T. Rose. Brit. Welding J. 7, 19-21(1960) Jan.

In heating a pipe or vessel locally to a circumferential butt weld, with the object of stress-relieving the weld, there is a danger that the local heating may itself result in the appearance of residual stresses. An approximate analysis indicates the level of thermal stress to be expected as a function of the length of pipe heated and the pipe mean radius and thickness. (auth)

15961

THE WELDING AND BRAZING OF CERTAIN COBALT-CONTAINING ALLOYS. W. J. Lepkowski and R. E. Monroe (Battelle Memorial Inst., Columbus, Ohio). Cobalt No. 7, 6-12(1960) June. (In English)

The family of cobalt-containing alloys primarily consists of iron-, nickel-, or cobalt-base materials. Welding processes are discussed according to the base metal, while brazing is discussed in terms of brazing alloys. Whatever the base or brazing alloy, there are certain characteristics that will apply both to welding and brazing. These generalizations are discussed. (B.O.G.)

15962

NON-METALLIC DISPERSIONS IN COBALT AND ITS ALLOYS. PART II. SINTERED HIGH-TEMPERATURE CHROMIUM—COBALT ALLOYS. Rudolph Palme [(Battelle-Institut, Frankfurt am Main).]. Cobalt No. 7, 13-25(1960) June. (In English)

The effects of non-metallic dispersions on the mechanical properties of cobalt and cobalt alloy sintered specimens were investigated. It is possible to produce sintered alloys of high carbide content having almost theoretical density. A small increase in sintering temperature and time from the level where highest room-temperature strength is achieved results in an improved creep resistance. Additions of NBC and TIN as well as Fe and Ni improve the creep strength of 30:70 chromium—cobalt alloys. The carbon content greatly affects the creep behavior. (B.O.G.)

15963

PROTECTION OF URANIUM BY ELECTROLYTIC NICKEL PLATING AND DIFFUSION. G. Chauvin, H. Coriou, and J. Hure (Centre d'Études Nucléaires, Saclay, France). Electrochim. Acta 1, 177-89(1959) July.

The production of electrodeposits of nickel on uranium, suitable for forming a barrier between uranium and aluminum under conditions of thermal diffusion, is described. The diffusion between the nickel layer and basic uranium is investigated. The best diffusion zones are obtained with nickel deposited from a bath free of boric acid, which avoids the production of the 400 to 500 ppm boron found in deposits from conventional baths. (B.O.G.)

15964

PREPARATION AND REFINING OF YTTRIUM METAL BY Y—Mg ALLOY PROCESS. O. N. Carlson, J. A. Haefling, F. A. Schmidt, and F. H. Spedding (Ames Lab., Ames, Iowa). J. Electrochem. Soc. 107, 540-5(1960) June.

Yttrium metal was prepared by the reduction of YF_3 with calcium forming a low melting Y-Mg intermediate alloy. Magnesium was removed by sublimation to produce yttrium metal sponge A method is described for removing oxygen and fluorine from the alloy by extraction with fused yttrium salts. The results of electron beam melting and zone refining are also presented. Some properties of yttrium metal of 99.9% purity obtained by the extraction refining process are discussed. (auth)

15965

URANIUM DIOXIDE NUCLEAR FUEL. Chester Placek and Edward D. North (Mallinckrodt Nuclear Corp., Hematite, Mo.). Ind. Eng. Chem. 52, 458-64(1960) June.

Nuclear fuel making is a new and still not-too-large addition to the chemical industry. But fuel producers are optimistic, look more to future needs than to current requirements. Uranium dioxide is the most popular nuclear fuel today, and will probably stay in first place for some time. Mallinckrodt Nuclear was the first commercial UO_2 producer. At its Hematite, Mo., plant, the firm makes UO_2 by first reacting uranium hexafluoride with aqueous ammonia to obtain ammonium diuranate (ADU). This compound is then dried, reduced to UO_2, and the dioxide worked mechanically into a variety of shapes and sizes. (auth)

15966

WELDING TANTALUM FOR HIGH-TEMPERATURE SYSTEMS. S. M. Silverstein (AVCO Corp., Stratford, Conn.); J. N. Antonevich and P. J. Rieppel (Battelle Memorial Inst., Columbus, Ohio); and R. P. Sopher (General Dy-

namics Corp., Groton, Conn.). Metal Progr. 77, No. 6, 103-9(1960) June.

Several miniature heat exchangers were fabricated by welding (tube to header) tantalum in an investigation of Ta welds. The process used was inert gas-shielded tungsten-electrode arc welding; welds were judged sound if no leaks could be detected with a mass-spectrograph helium leak detector and the grains of the welds were not too large. Studies were made on the C and O contents in an effort to relate them to the weldability of the metals. No simple relationship was apparent, but it is noted that high C content, low O content, or a combination of high C and high O contents improves weldability. Prior arc melting has the same effect. Ultrasonic welding was studied in order to see if it would reduce the grain size of the welds and hence improve strength; it was found to do so at an ultrasonically induced stress of 17,000 psi, but the susceptibility of the grain boundaries to etching attack was also increased, indicating more stress on the boundaries. Recommended procedures for the welding of Ta are given. (D.L.C.)

15967

DEEP DRAWING OF ALUMINUM. Charles Robert Vassel (Institut de Recherches des Metaux Non-Ferreux, Budapest). Rev. mét. 56, 394-8(1959) Dec. (In French)

The practical aspects of the important factors in deep-drawing of Al are discussed. The effects of composition, especially Fe and Si impurities, on H_2 absorption lattice defect formation, and dislocations are pointed out. The effects of the method of preparation of the plate for deep drawing are also considered. The criteria for qualifying plates for deep drawing are listed, and indirect tests for plates are given. (T.R.H.)

15968

CONSTRUCTION OF A LEAD CRYSTAL MONOCHROMATOR FOR NEUTRON DIFFRACTION STUDIES. D. F. Litvin (Central Scientific Research Inst. for Ferrous Metallurgy, USSR). Soviet Phys.–Cryst. 4, 623-7(1960) May.

Large single crystals of lead were grown. A method was developed for the electric-spark cutting of plates from single-crystal ingots with given orientation of the crystallographic axes. (auth)

15969

WELD METALS IN NICKEL-BASE ALLOYS. J. Heuschkel (Westinghouse Research Labs., Pittsburgh). Welding J. (N.Y.) 39, 236s-46s(1960) June.

The mechanical properties (stress values for various types of strain, ductility, and hardness) for welds in Ni-base alloys were investigated over a broad range of temperatures, −320 to +2200°F. The type of weld was either argon shielded or covered-electrode shielded, and the alloys studied were of the Ni-Ti, Ni-Cr-Fe-Nb, Ni-Cr-Fe-Ti, and Ni-Cu types. Graphs of all the data are given together with numerous microphotographs of the alloy structures. The results found were: Ni-Ti welds have a low-ductility dip centered at 1800°F; Ni-Cr-Fe-Nb welds have maximum hot ductility of the welds studied as well as excellent ductility and strength at low temperatures (which Ni-Ti and Ni-Cu also possess); Ni-Cr-Fe-Ti welds are hot brittle and crack sensitive; and Ni-Cu welds have low ductility above 1200°F, but high ductility below 800°F. (D.L.C.)

15970

ARC WELDING OF 5% Cr–0.5% Mo ALLOY STEEL PIPE. J. Bland (General Electric Co., Schenectady, N. Y.) and G. F. Tisinai (Standard Oil Co. of Indiana, Whiting). Welding J., (N.Y.) 39, 255s-65s(1960) June.

Unrestrained weldments were made using 5% Cr–0.5% Mo alloy-steel pipe and 5% Cr–0.5% Mo, 1.25% Cr–0.5% Mo, 25% Cr–12% Ni, or 25% Cr–20% Ni electrodes. The hardness and tensile properties were correlated for both 5% Cr–0.5% Mo alloy-steel pipe material and 5% Cr–0.5% Mo alloy weld deposits. The heat-affected zones of the 5% Cr–0.5% Mo alloy-steel pipe had adequate ductility even in the absence of preheat or postheat treatments. Postheat temperatures of 1250°F and above imparted appreciable ductility to 5% Cr–0.5% Mo weld metal; however, a temperature of 1400°F gave markedly more ductility and is preferred. If 1.25% Cr–0.5% Mo, 25% Cr–12% Ni, or 25% Cr–20% Ni electrodes were used for unrestrained weldments of 5% Cr–0.5% Mo alloy-steel pipe, no preheat or postheat treatments were needed to obtain adequate weld ductility. (auth)

15971

METHOD OF JACKETING A FISSIONABLE BODY. E. C. Creutz (to U. S. Atomic Energy Commission). U. S. Patent 2,924,877. Feb. 16, 1960.

A method for jacketing fuel elements is described. A fissionable body is fitted into a steel jacket, and a steel rimmed closure disk is inserted into the open end of the jacket. The jacket is then drawn through a die, and the rim of the disk is welded to the jacket to form an impervious seal.

15972

IRON COATED URANIUM AND ITS PRODUCTION. A. G. Gray (to U. S. Atomic Energy Commission). U. S. Patent 2,928,168. Mar. 15, 1960.

A method of applying a protective coating to a metallic uranium article is given. The method comprises etching the surface of the article with an etchant solution containing chloride ions, such as a solution of phosphoric acid and hydrochloric acid, cleaning the etched surface, electroplating iron thereon from a ferrous ammonium sulfate electroplating bath, and soldering an aluminum sheath to the resultant iron layer.

15973

METHOD OF FABRICATING A URANIUM–ZIRCONIUM HYDRIDE REACTOR CORE. I. F. Weeks and W. V. Goeddel (to U. S. Atomic Energy Commission). U. S. Patent 2,929,707. Mar. 22, 1960.

A method is described of evenly dispersing uranium metal in a zirconium hydride moderator to produce a fuel element for nuclear reactors. According to the invention enriched uranium hydride and zirconium hydride powders of 200 mesh particle size are thoroughly admixed to form a mixture containing 0.1 to 3% by weight of U^{235} hydride. The mixed powders are placed in a die and pressed at 100 tons per square inch at room temperature. The resultant compacts are heated in a vacuum to 300°C, whereby the uranium hydride decomposes into uranium metal and hydrogen gas. The escaping hydrogen gas forms a porous matrix of zirconium hydride, with uranium metal evenly dispersed therethrough. The advantage of the invention is that the porosity and uranium distribution of the final fuel element can be more closely determined and controlled than was possible using prior methods of producing such fuel elements.

Properties and Structure

15974 A-2525Z(WEC)

Westinghouse Electric Corp. Aviation Gas Turbine Div., Kansas City, Mo.

DEVELOPMENT OF NIOBIUM-BASE ALLOYS. Quarterly

Report No. 1. R. T. Begley. Aug. 15, 1958. 15p. Contract AF33(616)-5754.

Arc melted niobium-base binary alloys of Ti, Zr, Mo, V, W, Hf, and some ternary alloys were evaluated for workability, and some elevated temperature tensile tests were conducted. Recrystallization studies on alloys were continued. Levitation melting in vacuum was successfully accomplished on alloys for phase diagram studies. Data from x ray examination on Nb–Al and Nb–Hf systems are reported. (auth)

15975 CRFD-915

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THERMAL SIMULATION EXPERIMENTS WITH A UO_2 FUEL ROD ASSEMBLY. V. B. Lawson and J. R. MacEwan. Mar. 1960. 25p. (AECL-994). AECL.

Evidence is presented which shows that columnar grains can be induced to grow in high-density sintered uranium dioxide specimens by applying a steep temperature gradient at temperatures above 1700°C, but below the melting point of 2800°C. Columnar growth is apparently a result of the migration of large transverse voids, whose individual widths define the grains' cross sections, up a temperature gradient by a sublimation process. The grains grown by this process have a <111> preferred orientation along their columnar axis. A consequence of such void migration in operating fuel elements containing solid UO_2 pellets is the formation of a central void bounded by a region of oxide exhibiting columnar growth. (auth)

15976 CRMet-751

Atomic Energy of Canada Ltd., Chalk River, Ont.

EFFECT OF CARBON ON THE GRAIN REFINEMENT OF URANIUM. L. M. Howe. Apr. 1958. 30p. (AECL-579) AECL.

A study was undertaken on small uranium samples to find a suitable method for grain refinement and to determine the effect of carbon on the grain refinement. It was found that considerable grain refinement may be achieved in samples which were quenched from the beta phase and annealed at high alpha-phase temperatures. A study of the microstructures support a recrystallization mechanism for grain refinement by this process. The effect of carbon content on the magnitude of grain refinement in the surface layers is small whereas the effect on the interior of the sample is large; the degree of refinement increased with increasing carbon content within the range 10 to 1000 ppm. (auth)

15977 DMIC-128

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

A SUMMARY OF COMPARATIVE PROPERTIES OF AIR-MELTED AND VACUUM-MELTED STEELS AND SUPERALLOYS. D. C. Ludwigson and F. R. Morral. Mar. 28, 1960. 145p. Contract AF18(600)-1375. (PB-151085) OTS.

A compilation of comparative properties of air-melted and vacuum-melted steels and superalloys is presented. The data revealed that: The reduction in hydrogen content of large heats of low-alloy steels effected through vacuum pouring can lead to improved ductility. A reduction in gas, inclusion, and impurity content of low-alloy or chromium hot-work die steels that result from either vacuum-induction melting or consumable-electrode vacuum-arc remelting can lead to improved fatigue and impact properties, higher ductility, and better behavior under multiaxial stresses, but seldom improve tensile strength. The transition temperature, rupture strength, and elongation of ferritic and martensitic stainless steels may be improved by vacuum-induction melting. Improved cleanliness, better control of composition, and modifications of composition enabled by vacuum-induction melting led to improved stress-rupture, fatigue, and tensile properties in nickel-base superalloys. The tensile and rupture strengths of cobalt-base superalloys are affected but little by vacuum-induction melting, although rupture ductility improved significantly. The improved homogeneity of segregation-sensitive hardenable stainless steels and iron-base superalloys that result from consumable-electrode vacuum-arc remelting leads to improved tensile strength, ductility, fatigue strength, and stress-rupture properties in these alloys. (auth)

15978 DMIC-Memo-55

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

SELECTED REFERENCES ON BRITTLE FRACTURE. Don Owens and Lynne Doss. May 5, 1960. 66p. (PB-161205). OTS.

A bibliography which brings together the results of past and current studies on brittle fracture is presented. 822 references. (J.R.D.)

15979 HW-26003

Hanford Works, Richland, Wash.

PRELIMINARY REPORT ON THE ULTRASONIC PROPERTIES OF URANIUM. D. C. Worlton and E. C. Wood. Oct. 22, 1952. Decl. Dec. 3, 1959. 31p. Contract W-31-109-Eng-52. OTS.

A preliminary investigation was made of the use of ultrasonics for nondestructively measuring preferred orientation and grain size in uranium slugs. Tests were made which define, by a polar plot, the effect of preferred orientation on a reverberating ultrasonic pulse. The average grain diameter was correlated with ultrasonic absorption in grain size investigations. It is proposed that the absorption is largely a scattering phenomenon occurring at the grain boundaries. (C.J.G.)

15980 HW-48989

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SOME NEW TECHNIQUES IN THE USE OF ULTRASONIC ATTENUATION IN TESTING URANIUM FUEL ELEMENTS. C. L. Frederick. Mar. 11, 1957. Decl. Mar. 16, 1960. 17p. Contract [W-31-109-Eng-52]. OTS.

The ultrasonic attenuation method of testing uranium was studied by analyzing the amplitude distribution of the transmitted pulses. Several methods of pulse analysis were used. Variations in attenuation through a fuel element, both radially and along its length, were obtained from a movie camera record of the oscilloscope pulse display. A twenty-channel pulse-height analyzer was used to measure the pulse amplitude distribution for given elements. In testing one thousand solid fuel elements, most produced nearly symmetric pulse height distributions. These can be fit quite closely by a normal curve of error. These distributions were characterized by either the maximum or most probable pulse amplitudes. Metallographic grain size measurements showed good correlation with the ultrasonic measurement in most cases. Poor correlation was probably due to other factors causing ultrasonic attenuation, some of which are grain orientation, porosity, inclusions, and cracks. Several possibilities for improving fuel element quality are suggested. A possible instrument for performing tests to determine if instability under irradiation might occur are described, and plans to build and evaluate it are discussed. (auth)

15981 HW-56391

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

VARIABLE HYDROGEN DINGOT TEST. R. E. Olson and O. W. Rathbun. June 13, 1958. Decl. Mar. 31, 1960. 17p. Contract W-31-109-Eng-52. OTS.

Dingots of uranium with hydrogen content of 2.0 to 5.3 ppm were tested for braze porosity with part of the rods heat treated in Nu-Sal (potassium chloride–sodium chloride) and the other part treated in the standard lithium–potassium carbonate bath. Primary results of the test revealed that fuel elements will contain less braze porosity due to hydrogen content when heat treated in Nu-Sal. (W.D.M.)

15982 HW-62442

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PYROPHORICITY OF URANIUM IN REACTOR ENVIRONMENTS. G. E. Zima. Jan. 22, 1960. 71p. Contract AT(45-1)-1350. OTS.

Current information relative to the pyrophoricity of uranium is reviewed and aspects of this troublesome phenomenon which can support further investigation are considered. Information on metallic uranium fuel element fires, up to the present, provide an inadequate base for extrapolation to future operations because of existing uncertainty with respect to causative mechanisms and fire control techniques. Experience at Hanford reactors indicates conditions which tend to reduce the fuel element fire hazard. These include minimizing of the in-core residence time of a fuel element with a cladding defect which permits uranium corrosion, employment of removal and discharge techniques which do not contribute to the deterioration of the fuel element, and minimizing of the time interval between discharge and entry into the retention basin. (J.R.D.)

15983 JPL-PR-30-18

California Inst. of Tech., Pasadena. Jet Propulsion Lab.

TENSILE AND CREEP BEHAVIOR OF GRAPHITES AT TEMPERATURES ABOVE 3000°F. Progress Report. H. E. Martens, D. D. Button, D. B. Fischbach, and L[eonard] D. Jaffe. Oct. 15, 1959. 22p. Contract NASw-6.

The work described is taken from studies using fifteen variously selected blocks of synthetic graphite. Measurements were made at temperatures above 3000°F. At 5000°F the tensile ductility of one block tested decreased from 40 to 1% when the strain rate was increased from 5×10^{-5} to 1×10^{-2} sec^{-1}. The strength increased slightly. At 4650°F the tensile creep rate for another block tested was proportional to the square of the applied stress. At 4800°F a specimen from another block which had been pre-heated to 5100°F had a creep rate of 1.5×10^{-5} sec^{-1}, under a stress of 2800 psi, as compared to a creep rate of 4×10^{-5} sec^{-1} for a specimen which had not been pre-heated. Analysis of the creep data was attempted in terms of three different creep equations. The equation $\epsilon = A + B \log t + Ct$ gives the most satisfactory description of the data in agreement with Davidson and Losty. B and C were found to be Arrhenius functions of the temperature and there is evidence that they represent two distinct thermally activated processes. Creep recovery can be approximated by a logarithmic time dependence, though a distribution of relaxation processes is a better approximation. (auth)

15984 NAA-SR-Memo-1795

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THE VAPOR PRESSURE OF BeO. T. A. Milne. Dec. 7, 1956. 20p. OTS.

The literature pertaining to the vaporization behavior of BeO is critically reviewed. The usefulness of thermodynamic calculations based on spectral and thermochemical data is illustrated. Calculations in the literature which were based on doubtful or incorrect assumptions are discussed. The reaction of BeO with W is considered in the light of the high temperature species which might be present. Suggestions for further work on the vaporization behavior of BeO are listed. (auth)

15985 NAA-SR-Memo-5150

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

RESISTIVITY OF U–Mo ALLOY FUEL MEASUREMENTS AND STANDARDS TEST NO. 2352. G. A. Stone. Apr. 6, 1960. 5p. OTS.

The electrical resistivity of thirty-nine U–10 wt.% Mo fuel rods at room and liquid nitrogen temperatures was determined. The samples were as-cast, heat-treated at 900°C for 24 hours (water quenched), or heat-treated at 500°C for 115 hours (air cooled). (W.D.M.)

15986 NASA-TN-D-172

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

APPLICATION OF RATE-TEMPERATURE PARAMETERS TO TENSILE DATA FOR MAGNESIUM ALLOYS AND A RELATION BETWEEN THE LARSON-MILLER CONSTANT AND THE ACTIVATION ENERGY. Charles R. Manning, Jr. May 1960. 23p. OTS.

The Larson-Miller and Dorn rate-temperature parameters were successfully applied to published data to take into account the effect of strain rate and temperature on tensile properties of six magnesium alloys at strain rates from 0.005 $minute^{-1}$ to 5.0 $minute^{-1}$ at 100 to 800°F. The values of the Larson-Miller constant and the activation energy used in the Dorn parameter were determined for each material. A relation between the values of the Larson-Miller constant and the activation energy was determined for magnesium and aluminum alloys. (auth)

15987 NP-8717

Northwestern Univ., Evanston, Ill. Technological Inst.

STRAIN AGING IN Ag BASE Al ALLOYS. Technical Report No. 1. A. A. Hendrickson and M. E. Fine. Mar. 18, 1960. 16p. Project No. 031-618. Contract NONR-1288(11).

Investigation of the tensile properties of Ag based Al alloy crystals was undertaken because it appeared attractive for studying strengthening effects due to Suzuki locking with minimum complication. Initial yield drops were observed in the crystals having higher Al content and in all crystals (2, 3, 4, and 6 at. % Al) after strain aging at room temperature. No yield drops were found in similarly grown and tested Ag crystals. The magnitude of the yield drop from strain aging was found to depend on the aging time, aging temperature, alloy composition and, to a lesser extent, on the strain increment and testing temperature. While Al additions increase the room temperature critical resolved shear stress rather slowly, they strongly increase its temperature dependence. The authors attribute only the yield effects to Suzuki locking and the major portion of the solid solution strengthening to changes in the dislocation density, width, and arrangement which occur on alloying Ag with Al. (auth)

15988 NP-8733

Aeroprojects, Inc., West Chester, Penna.

FUNDAMENTALS OF ULTRASONIC WELDING, PHASE II. Bimonthly Progress Report No. 6 [for] October 16 to December 15, 1959. Dec. 30, 1959. 42p. Contract NOas-59-6070-c.

An investigation of the relationship of various material properties to weldability indicated that ultrasonic weldability depends in part upon room temperature hardness. A study of the threshold curve substantiated previous tentative conclusions that the minimum power locale in the curve is associated with the best impedance match between the transducer and the weld. An autoradiographic technique was developed and applied to the inspection of oxide distribution at the weld interface. Surface film fragments can be distinguished from voids. Oxide thicknesses in the range of 500 to 3000A exhibited a significant effect on weld strength and welding parameters. A positive-replica technique was used in an electron microscopic study of ultrasonically welded iron and copper monometal specimens. Characteristics of the interfacial mechanics and metallurgy are given. (See also NP-8340.) (C.J.G.)

15989 NP-8735

Westinghouse Electric Corp. Research Labs., Pittsburgh.
DEVELOPMENT OF NIOBIUM BASE ALLOYS. Third Quarterly Progress Report Covering Period November 1, 1959 to February 1, 1960. R. T. Begley and A. I. Lewis. Apr. 15, 1960. 24p. Contract AF33(616)-6258.

The mechanical properties of a number of niobium alloys containing binary additions of Al, Cr, Zr, W, and Mo were evaluated. Two niobium alloy ingots were also Dynapack extruded with fair results. Mechanical property data were obtained on the extruded material. A Nb-5 wt.% V-5 wt.% Mo-1 wt.% Zr alloy exhibited a 34,200 psi yield strength at 2200°F. Preliminary hot hardness data were obtained on pure Nb and several niobium base alloys. (See also NP-8392.) (auth)

15990 NRL-5460

Naval Research Lab., Washington, D. C.
CRACK PROPAGATION TESTS OF HIGH-STRENGTH SHEET MATERIALS. IV. THE EFFECT OF WARM PRESTRAINING. J. E. Srawley and C. D. Beachem. Jan. 29, 1960. 20p.

Previous reports in this series issued as NRL-5127, NRL-5263, and NRL-5348.

Evidence is presented that the weakening effect of the cracks provided in crack-propagation test specimens of high-strength sheet steels may be substantially mitigated by straining at moderately elevated temperatures, where the mode of fracture is entirely shear, before testing at lower temperatures. The improvement in load-bearing capacity of the specimens resulting from the pre-straining treatment is greater the lower the testing temperature. The effect is believed to be mainly a result of blunting of the crack fronts in the vicinity of the specimen surfaces by plastic flow and shear cracking during pre-straining. (For Part III see NRL-5348.) (auth)

15991 NYO-7081

Massachusetts Inst. of Tech., Cambridge.
IMPERFECTIONS IN METALS. THE EARLY STAGES OF PLASTIC DEFORMATION IN COPPER. Technical Report No. 24. D. A. Thomas and B. L. Averbach. May 2, 1958. 29p. OTS.

Small plastic strains in the range 1 to 500×10^{-6} were measured with electrical resistance strain gages for high-purity polycrystalline copper tensile specimens. Plastic extension was observed at stresses above about 1000 lb/sq in., and the plastic strain at a given stress was shown to depend on the third power of the grain size. A deformation mechanism is proposed in which the movement of the dislocations produced at small strains is blocked by grain boundaries. This picture predicts the observed grain size dependence and accounts for the shape of the stress-plastic strain curve and for the magnitude of the plastic strain. Creep was observed in all specimens at stresses slightly above those required for the first observable plastic deformation. The creep rate at constant stress was greater the larger the grain size. (auth)

15992 NYO-8797

Columbia Univ., New York.
THE STABILIZATION OF AQUEOUS SUSPENSIONS OF THORIUM OXIDE. Progress Report [for] November 1, 1958–February 29, 1960. Victor K. La Mer, Robert H. Smellie, Jr., Tibor Mahr, and Nora Liu. Apr. 25, 1960. 29p. Contract AT(30-1)-2267. OTS.

Aspects of thorium dioxide stability in suspensions were examined. The investigation included a search for stabilizing agents which are better than those usually considered. Also included were studies of adsorption and stabilization correlation with electrophoretic mobility and conductometry, and thoria stability as a function of thorium oxalate ignition. Results of these investigations must be coupled with knowledge of thorium oxide particle electrokinetic behavior to relate stability to surface chemistry. A method for determining the electrophoretic mobilities of particles in a vertically oriented cell in which the determination is made by averaging measurement of the velocities obtained when the applied potential works with and then against gravity settling is discussed. Further detailed electrophoresis measurements and continued work on adsorption of stabilizing agents are indicated. (J.R.D.)

15993 SCNC-249

Sylvania-Corning Nuclear Corp., Bayside, N. Y.
DIMENSIONALLY STABLE ALLOYS. Interim Report. A. L. Eiss and H. S. Kalish. Oct. 30, 1957. Decl. Mar. 30, 1960. 47p. Contract AT-30-1-GEN-366. OTS.

The development of dimensionally stable alloys for high temperature reactor application is discussed. Cold pressing followed by sintering was determined to be the most satisfactory method. Evaluation of alloys by α-β thermal cycling indicated the superiority of U–Mo and U–Nb alloys. A few specimens containing small additions of Mo, Nb, and Si were irradiation tested in the Materials Testing Reactor. Of these, the Nb alloy (1.6 wt.% Nb) appeared to be most stable. The Mo alloys were somewhat less satisfactory and the alloys containing Si were not stable. (auth)

15994 SEP-228

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.
DIMENSIONAL INSTABILITY OF URANIUM-I. First Annual Progress Report for June 30, 1955 to June 30, 1956. R. Resnick and L. Seigle. June 1956. Decl. Mar. 30, 1960. 23p. Contract AT-30-1-GEN-366. OTS.

The growth of alpha-uranium under irradiation has been attributed to the anisotropic diffusion of lattice vacancies and interstitial atoms. To test this theory, measurements were made to determine the influence of grain size on radiation growth rates. Grain size affected the growth rate, but not as much as predicted. Other diffusional processes which might produce growth are discussed. Attempts are being made to determine the anisotropy of self-diffusion in alpha-uranium. Experimental difficulties are formidable, but it is felt that the measurements are possible. A determination has been made of the diffusion coefficient of gold in polycrystalline alpha-uranium at 640°C which yielded $D \cong 2 \times 10^{-14}$ cm^2/sec. Studies of the formation of voids in metals during diffusion confirm that voids are heterogeneously

nucleated, probably by oxide particles. The same may be true of voids formed in irradiated uranium. (auth)

15995 TID-5934

Illinois. Univ., Urbana.

DIFFUSION IN METALS. Progress Report and Publication List. David Lazarus. June 1, 1960. 53p. Project No. 3. Contract AT(11-1)-67. OTS.

Diffusion profiles for Fe in Cu and Ag were determined by gamma-counting of the individual sections prior to radiochemical separation of the isotopes. The data indicate that pure volume diffusion occurred in all specimens. Results for the mass dependence of diffusion of Fe^{59} and Fe^{55} in Cu at 768°C are reported. Data on the pressure dependence of anelastic relaxation time in AgZn, pressure effects on the annealing of quenched vacancies in gold, and the variation of ΔV_m for NaCl with temperature are given. In all cases, the rates of the diffusion-limited phenomena were found to decrease essentially exponentially with increasing pressure. The activation volumes for the impure alkali halide crystals all revealed a strong temperature dependence. A complete inconsistency of these results with those expected for a hard-sphere model of a solid was observed. A plastically deformed AgZn specimen exhibited anelastic relaxation about 500 times faster than the annealed specimen at 100°C but only about 5 times faster at 143°C. (C.J.G.)

15996 TID-5940

Nuclear Materials and Equipment Corp., Apollo, Penna.

BURST-TESTING OF LARGE DIAMETER ZIRCALOY-2 TUBING AT 300°F. Mar. 16, 1960. 16p. For General Nuclear Engineering Corp. Contract AT(38-1)-200, Subcontract 40-4-PTR. OTS.

The results of tests to determine the ultimate strength and character of the burst of nominal 5.0 in. OD by 4.75 in. ID by 0.125 in. wall thickness, seam welded, Zircaloy-2 tubing at 300°F are presented. (C.J.G.)

15997 TID-5956

Iowa. State Univ., Iowa City.

PHASE EQUILIBRIA, KINETIC AND THERMODYNAMIC STUDIES OF SOME RARE EARTH METAL OXIDE AND NITRIDE SYSTEMS. Technical Progress Report. L. Eyring, Karl S. Vorres, and H. S. Schuldt. May 31, 1960. 133p. Project No. 5. Contract AT(11-1)-72. OTS.

The physical, thermodynamic, and high temperature properties, including phase relationships of oxide and nitride systems of the rare earth metals, were studied. Ytterbium rich praseodymium oxide phases generally favored cubic symmetry rather than rhombohedral or hexagonal. The lattice parameter of RO_x, where R = Pr, $(Pr_{0.93}\ Yb_{0.07})$, and $(Pr_{0.82}\ Yb_{0.18})$, increased as "x" decreased, where x is the per cent of oxygen. The surface areas, particle sizes, and aggregate size distributions of RO_x compounds, where "x" varied from 1.501 to 1.839, were measured. Absolute rates and activation energies of the thermal decomposition of RO_x compounds were measured over a wide range of temperatures in vacuo. Physical and metallurgical properties of the lanthanum–lanthanum nitride and cerium–cerium nitride systems were investigated. Microhardness measurements were made on cerium and lanthanum oxides. Interatomic distances and cell structures were determined through phase studies for TbO_x compounds. Activation energy and rate constant determinations by the continuous temperature increase method are discussed. (C.J.G.)

15998 WAL-TR-140/27

Watertown Arsenal Lab., Mass.

DETECTION BY NONDESTRUCTIVE TESTS OF OVERHEATING IN 2014-T6 ALUMINUM ALLOY. Patrick C. McEleney and Everett L. Reed. May 1960. 45p. DA Project 5B93-32-002. (PB-161516). OTS.

Ultrasonic attenuation tests proved to be successful in the detection of "overheating" or "burning" in 2014-T6 aluminum alloy. Heretofore overheating was detected only by metallographic examination. Correlation between ultrasonic attenuation tests and metallographic studies of a series of overheated and nonoverheated 2014-T6 aluminum alloy samples was successfully accomplished. Liquid penetrant, radiographic and electromagnetic tests were also applied in certain instances to detect this condition. (auth)

15999 AEC-tr-4080

INSPECTION OF STRUCTURE AND MECHANICAL PROPERTIES OF STEEL PRODUCTS BY MAGNETIC ANALYSIS. M. N. Mikheev. Translated from Trudy Inst. Fiz. Metal. Akad. Nauk S.S.S.R., Ural. Filial No. 20, 163-8 (1958). 9p. JCL or LC.

A review of magnetic inspection and analysis methods for use in determining the structural state and mechanical properties of steel and steel products is presented. An outline of the problems which must be solved in the next few years to ensure wider development of these methods is included. (J.R.D.)

16000 AERE-Trans-846

France. Commissariat à l'Énergie Atomique, Paris.

A COMPARATIVE STUDY OF THE ALLOTROPIC TRANSFORMATIONS OF URANIUM AND IRON AND THEIR STRUCTURAL CONSEQUENCES. P. Lehr. Translated by E. Towndrow (U.K.A.E.A. Atomic Energy Research Establishment) from report CEA-800. 78p.

This paper was previously abstracted from the original language and appears in NSA, Volume 13, as abstract No. 16972.

16001 AERE-Trans-849

RARE-EARTH METAL BORIDES. G. V. Samsonov. Translated by F. Hilton from Uspekhi Khim. 28, 189-217 (1959). 40p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 10103.

16002 JPRS-2526

SEMICONDUCTOR THERMOCOUPLES FOR HIGH TEMPERATURE USES. P. S. Kislyi (Kislyy) and G. V. Samsonov. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 133-7(1959). 13p. OTS.

High-melting semiconductor compounds paired with high-melting metallic compounds of C, N, Si, and B were considered for possible use as high-temperature thermocouples stable in molten metals and other noninert media. The electromotive forces of the following pairs were studied: $B_4C-MoSi_2$, B_4C-TiC, B_4C-TiB_2, B_4C-ZrB_2, $CrSi_2-TiC$, and $CrSi_2-MoSi_2$. A representative plot of electromotive force vs. temperature in the range 200 to 1000°C is given for $B_4C-MoSi_2$, B_4C-TiC, and $CrSi_2-TiC$. In general, linear temperature dependence commences at ~400°C, except for $CrSi_2-MoSi_2$ which has a complex temperature dependence up to 600°C. Also, stable phases are formed whose electric properties are unchanged with time, except for $CrSi_2-MoSi_2$. A scheme for the construction of thermocouples using the above materials is given; such a thermocouple consists of a metallic compound tube containing a rod of borated graphite or $CrSi_2$. Techniques for the borating of graphite rods and the welding of the junctions between the borated graphite rods and TiC and ZrB_2 tubes are given.

Thermocouples with $MoSi_2$ tubes oxidize in air at ~1500°C; a SiO_2 film is formed on the surface, which then protects it from further oxidation. Thermocouples with boride tubes were found to be stable in molten pig iron, brass, and steel. Calibration graphs are given for several thermocouples with borated graphite rods; they all are linear above 300 or 400°C, and the electromotive forces exceed those of metallic thermocouples presently used in industry. The errors in measurement caused by the high heat conductivity of the above materials and devices to compensate for this effect are discussed. (D.L.C.)

16003

A STUDY OF SOME TEMPERATURE EFFECTS ON THE PHONONS IN ALUMINUM BY USE OF COLD NEUTRONS. K.-E. Larsson, U. Dahlborg, and S. Holmryd. Arkiv Fysik 17, 369-92(1960). (In English)

Using the cold neutron scattering technique, about 300 phonons were determined in a single aluminum crystal at room temperature to define 10 pairs of dispersion curves. Investigations were made of the variation of frequencies, phonon line widths and multi-phonon spectra in the temperature range $293 \leq T \leq 932$°K. For a particular direction in the crystal lattice it is shown that the frequencies vary about 15% over this temperature range. The line widths are of such a magnitude that the derived phonon mean free paths vary from about 5 phonon wavelengths at 600°K to about 1.5 phonon wavelengths at 930°K. The observed multi-phonon spectra are found to agree with calculated differential cross sections in the incoherent approximation. (auth)

16004

CHANGES OF INTERNAL FRICTION WITH TEMPERATURE FOR POLYCRYSTALLINE URANIUM. Yu. N. Sokurskii and Yu. V. Robkov. Atomnaya Energ. 8, 348-53 (1960) Apr. (In Russian)

The internal friction in specimens heated at various rates was measured by the attenuation of torsional oscillations. Polycrystalline uranium specimens annealed in γ phase, tempered in the γ and α phases, and recrystallized, were used. It is shown that the increasing rate of internal friction is slowed with time and the increment of internal friction is in proportion to the rate of heating. The increment of friction is related to the variations of temperature due to the anisotropic thermal expansion factor. Reduced internal stresses due to grain enlargement or the appearance of prevailing orientation reduced the increment of friction. Macroscopic deformation was also observed in the specimen during the heating process. An enhanced internal friction was observed in thermally anisotropic zinc but was not observed in metals with isotropic thermal expansion factors (aluminum and molybdenum). (tr-auth)

16005

STUDY OF THE SYSTEMS $Fe_2O_3-La_2O_3$ AND $Fe_2O_3-Sc_2O_3$. Jeannine Cassedanne and Hubert Forestier (Université, Strasbourg). Compt. rend. 250, 2898-2900 (1960) Apr. 25. (In French)

The x-ray analysis and the thermomagnetic study of the $Fe_2O_3-Sc_2O_3$ system in the solid phase show the existence of solid solutions of the type αFe_2O_3 and Sc_2O_3. The $Fe_2O_3-La_2O_3$ system shows only the existence of this compound without solid solution. (tr-auth)

16006

A COMBINATION OF LANTHANUM SESQUIOXIDE WITH NICKEL PROTOXIDE. Marc Foëx, André Mancheron, and Martine Liné. Compt. rend. 250, 3027-8(1960) May 2. (In French)

The study of the system formed by lanthanum sesquioxide with nickel protoxide has shown the existence of the compound La_2NiO_4. The compound can be prepared from equimolecular mixtures of the oxides by simple fritting at 1500°C or by fusion in a solar furnace at 1750°C. The crystallographic constants were determined as $a = 3.86_4 \pm 0.003$, $c = 12.63_0 \pm 0.010$, and $c/a = 3.26_9$. A compound with the formula $LaNiO_3$ was also prepared by decomposition at 500 to 600°C of a mixture of the nitrates. This crystal has a structure of the perovskite type and is almost cubic with $a = 3.85$ A. Lanthanum oxide also combines with CoO and CuO to give the compounds La_2CoO_4 and La_2CuO_4 which appear to have a more complex structure than that of La_2NiO_4. (J.S.R.)

16007

WERALLOY—NEW SUPERHEAVY METAL ALLOY. D. Heuer. Feingerätetechnik 9, No. 2, 85-8(1960). (In German)

A very high density machinable W alloy is described which is suitable for radioisotope containers and heavy-duty electrical contacts. The alloy is produced by mixing 6% Ni carbonyl powder, 4% freshly reduced Cu powder, and 90% reduced W powder in a porcelain ball-mill for 2 hours, pressing, sintering in H_2 at 900°C, and then at 1400 to 1500°C. The alloy has a density of 16.5 to 17 and a Brinell hardness of 280 to 310 kg/mm^2. Oxidation stability up to 400°C is very good, and even higher temperatures are possible with alkaline ferricyanide pickling and galvanic Ni plating. (T.R.H.)

16008

SOME INVESTIGATIONS ON THE URANIUM—THORIUM—CARBON SYSTEM. N. Brett, D. Law, and D. T. Livey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 44-53(1960) Apr. (In English)

The dicarbides of uranium and thorium were prepared by sintering mixtures of the elemental powders at 1500 and 1800°C, respectively. Uranium dicarbide is stable in air at room temperature; in pellet form as prepared it breaks down in dry air between 200 and 300°C and in moist argon between 300 and 400°C. Thorium dicarbide decomposes rapidly at room temperature by reaction with atmospheric moisture. The system UC_2-ThC_2 was investigated by preparation of fused specimens of mixed crystals and examination of these by x ray and by microscope. The evidence from both sources shows that the system is one of complete solid solubility although the middle ranges of composition are poorly crystalline. Stability tests on mixed crystals of dicarbides show that they are stable to between 200 and 400°C in dry oxygen, the temperature of oxidation increasing from ~200°C at the ThC_2 end of the system to ~400°C at the UC_2 end. Oxidation forms mixed crystals of UO_2-ThO_2 cubic solid solution. Some information is given on uranium—thorium—carbon compacts containing principally the monocarbides. X-ray examination indicates that this system also is one of complete solid solubility. (auth)

16009

THE STRUCTURAL AGEING CHARACTERISTICS OF ALUMINIUM—COPPER—LITHIUM ALLOYS. J. M. Silcock (Univ. of Liverpool). J. Inst. Metals 88, 357-64 (1960) Apr.

An x-ray study was made of aluminum—copper—lithium alloys aged at 165°C, and also of the effect on aging of additions of 0.1 wt.% cadmium and of prior cold work. The main precipitates at 165°C are θ'', θ', T_1, and δ'. θ'' and θ' occur in binary aluminum—copper alloys. T_1 is a ternary compound, also formed as an equilibrium precipitate, and

δ' is an $AuCu_3$-type superstructure based on the aluminum lattice and found in binary aluminum–lithium alloys. Two other intermetallic compounds that occur in the ternary diagram (T_B and T_2) were not observed on aging at 165°C. In the aluminum–copper alloys θ' is nucleated by lithium, but in the cadmium-containing alloys its formation is retarded by small additions and advanced by moderately high additions of lithium. Cold work nucleates θ', and in low-copper alloys cold work nucleates T_1. (auth)

16010

CONSTITUTION OF NICKEL-BASE TERNARY ALLOYS. III. NICKEL–ALUMINIUM–SILICON SYSTEM. IV. NICKEL–MOLYBDENUM–TITANIUM SYSTEM. V. NICKEL–CHROMIUM–SILICON SYSTEM. R. W. Guard and E. A. Smith (General Electric Research Lab., Schenectady, N. Y.). J. Inst. Metals 88, 369-74(1960) Apr.

The phase relationships and terminal solid solubility in nickel at 1100°C were determined for the nickel-rich portion of the ternary system nickel–aluminum–silicon. Two ternary compounds were found in this region. It was observed that although Ni_3Al and Ni_3Si are isostructural, they do not form a continuous series of solid solutions. The terminal solid solubility in nickel and the phase relationships that exist in the nickel-rich section of the nickel–molybdenum–titanium system were determined at 900 and 1175°C. Two ternary compounds, ψ and Ξ [$Ni_6(Mo,Ti)$], were found, both of which undergo some kind of transformation on cooling to room temperature. The structures of ψ and Ξ are complex. The phase relationships and terminal solid solubility in nickel at 900 and 1100°C were examined for the nickel-rich alloys in the system nickel–chromium–silicon. One ternary compound $\psi(Ni_3Cr_2Si)$ was found, but its crystal structure is complex. (auth)

16011

METALLOGRAPHIC STUDY OF ZIRCONIUM–HYDROGEN ALLOYS. D. Whitwham (Centre de Recherches, Antony, France). Mém. sci. rev. mét. 57, 1-15(1960) Jan. (In French)

The metallographic structure of zirconium-hydrogen alloys (up to 65 at.% H_2) was correlated with the equilibrium diagram. This method gives a eutectoid composition of 36 ± 2 at.% H_2 and confirms the existence of two distinct hydrides δ (cubic) and ϵ (tetragonal), which are related by a pseudo-martensitic transformation. Other micrographic observations illustrate the precipitation of hydride from solid solution, and the influence of hydrogen on the embrittlement of zirconium. (auth)

16012

DEMONSTRATION OF A REGENERATION PHENOMENON IN SINGLE CRYSTALS OF α IRON OR α URANIUM BY NUCLEUS PERSISTENCE DURING THE ALLOTROPIC TRANSFORMATIONS $\alpha \rightleftharpoons \gamma$ IN IRON AND $\alpha \rightleftharpoons \beta$ IN URANIUM. Gérard Donzé and René Faivre (Ecole Nationale Supérieure de la Métallurgie et de l'Industrie des Mines, Nancy, France). Mém. sci. rev. mét. 57, 16-22(1960) Jan. (In French)

A crystal of α iron or α uranium containing traces of impurities such as carbon or nitrogen is deformed with the original orientation after having undergone the double transformation $\alpha \rightarrow \gamma \rightarrow \alpha$ in the case of iron or $\alpha \rightarrow \beta \rightarrow \alpha$ in the case of uranium provided that one does not exceed the transformation temperature by more than a few degrees. All the observed facts can be explained if one assumes that the nuclei of the low-temperature structure are preserved within the high-temperature structure. (auth)

16013

ELECTRON MICROSCOPE STUDIES ON ELECTROLYTICALLY POLISHED ALUMINUM SURFACES. Maria Gy-Holló (Institut de Recherches de Physique Technique de l'Academie des Sciences de Hongrie, Budapest). Mém. sci. rev. mét. 57, 23-34(1960) Jan. (In French)

A systematic study of the oxide films produced by electrolytic polishing was made by the electron microscope. Cellular structure formation in the oxide film derives from the anisotropy of the rates of oxidation and dissolution, which are functions of the crystal orientation. The relation of the oxide cellules to the voltage is parabolic, whereas it is linear under the conditions of anodic oxidation. (auth)

16014

DETERMINATION OF SOME PHYSICAL PROPERTIES OF PLUTONIUM METAL. J. G. Ball, J. A. Lee, P. G. Mardon, and J. A. L. Robertson. Mém. sci. rev. mét. 57, 49-56(1960) Jan. (In French)

The phase transitions in plutonium metal were examined by means of thermal analysis, electrical resistance, and dilatometry. The results show that probably six allotropic modifications exist between room temperature and the melting point, 640°C. Very large hysteresis effects are observed for the lower temperature transitions. X-ray examination has shown that only the δ- and ϵ-plutonium patterns are simple, these phases being respectively face-centered cubic and body-centered cubic. The specific heat of α-plutonium has been determined by a simple calorimetric method. The value proves to be unusually high and is compared with the results for other actinide elements. An estimate has been made of the thermal conductivity of α-plutonium by Kannaluick's method; the value is extremely low for a metallic element. (auth)

16015

GROWTH OF SLIP BANDS AND THE NUCLEATION OF CRACKS IN MAGNESIUM OXIDE. J. Washburn and A. E. Gorum (Univ. of California, Berkeley). Mém. sci. rev. mét. 57, 67-72(1960) Jan. (In French)

Low temperature plastic deformation of magnesium oxide crystals takes place entirely by growth of $\{1\,1\,0\}\langle 1\,\bar{1}\,0\rangle$ slip bands. The shear strain within a band remains constant at about 10% as it widens. Therefore dislocation motion is taking place only at the interfaces between deformed and undeformed portions of wide slip bands. The pile up at an intersection may be visualized as a short segment of tilt boundary that grows in length as the bands grow in width. (auth)

16016

THE INFLUENCE OF IMPURITIES IN THE RECRYSTALLIZATION OF VERY HIGH-PURITY ALUMINUM. J. C. Blade. Mém. sci. rev. mét. 57, 73-9(1960) Jan. (In French)

The recrystallization characteristics of some specimens of aluminum of very high purity (between 99.987 and 99.997 per cent Al) were studied after various degrees of cold work and after different thermal treatments carried out before the final cold working. It was observed that the behavior varied to a considerable extent between one specimen and another and this must be attributed not to the total amount of impurity, but to the individual contents of the principal impurities, i.e., Fe, Cu, and Si. It was established that the thermal history and the degree of cold working of a specimen also have considerable importance. The effects of each impurity element were determined by a statistical analysis of the results. In general, it was established that the presence of iron slows recrystallization, although the importance of the effect is influenced by the thermal pre-history and the degree of cold working. It

was found that the effects of Si and Cu are influenced strongly by variations in the thermal treatments and that in certain cases the presence of Si or Cu may bring about a reduction in the temperature of recrystallization. It was found possible to show that the observed acceleration of recrystallization could be explained by the interaction of particular impurity elements which lessen the retarding effect of specific elements, and more particularly that of iron. The influence of the preliminary thermal treatment of the specimens is, it is thought, related to variations in the distribution of the impurity elements. (auth)

16017

COLUMBIUM ALLOYS TODAY. L. P. Jahnke, R. G. Frank, and T. K. Redden (General Electric Co., Cincinnati). Metal Progr. 77, No. 6, 69-74(1960) June.

Niobium is attractive as a metal or alloy for use at high temperatures and in the fields of nuclear energy and space travel because of its high melting point (4470°F), good intrinsic ductility, reasonable chemical resistance, low thermal neutron capture cross section, and low density (7.9 g/cm^3). The current prices and delivery times of commercial Nb are a little lower, although still high. Progress made from 1955 to 1960 in the removal of C, O, and N from Nb is shown. Problems commonly encountered in processing (casting) Nb alloys and testing are described; it is best to conduct high-temperature tests in vacuum. Some data are given and plotted (2000°F) for the effects of alloying elements (e.g., Zr, Ti, Mo, W, C, and O) on the oxidation resistance and strength of Nb. Commercially available Nb alloys are given together with laboratory and pilot alloys, and strength vs. temperature and time plots are given for some of them. The future of Nb alloys is discussed. (D.L.C.)

16018

LITHIUM IN ALUMINUM—X2020. E. H. Spuhler, A. H. Knoll, and J. G. Kaufman (Aluminum Co. of America, New Kensington, Penna.). Metal Progr. 77, No. 6, 80-2 (1960) June.

An Al—Cu—Li alloy (4.5% Cu, 1.1% Li, 0.5% Mn, 0.2% Cd) having high strength over the temperature range 200 to 400°F was developed and has the designation number X 2020-T 6. It has low density and high modulus of elasticity, which makes it attractive for applications involving buckling, and about 10% is saved in weight over other high-strength Al alloys. Fatigue tests revealed that X 2020 is notch-sensitive, but this sensitivity can be avoided in aircraft by appropriate design. Aging behavior of X 2020 is also discussed. (D.L.C.)

16019

FLIGHT IN THE THERMOSPHERE. IV. MATERIAL REQUIREMENTS FOR RADIATIVE SYSTEMS. William S. Pellini (U. S. Naval Research Lab., Washington, D. C.) and William J. Harris, Jr. (National Academy of Sciences, Washington, D. C.). Metal Progr. 77, No. 6, 83-97(1960) June.

Possible high-temperature materials for use in a thermal protection system composed of an insulated radiative heat shield are discussed. Among the materials considered are Mo and Nb alloys, Ta, W, and nonmetallic materials like ceramics, borides, nitrides, carbides, and graphites. The above materials are analyzed for the relation of radiative wall temperature to heat input at various emissivities, and graphs are given for two cases, high and low stresses. The importance of high emissivity is emphasized, for it gives higher allowable heat fluxes. It is concluded that high-temperature alloys can be used only up to 1500°F and Mo and Nb up to 2500°F (if fabrication and oxidation problems are solved) in thermal protection systems. Materials for use in insulation and in the cool substructure are also discussed. It is concluded that further developments are necessary in all fields. (D.L.C.)

16020

OLD ZIRCONIA AND NEW ZIRCONIUM. M. Schofield. Metallurgia 61, 161-2; 166(1960) Apr.

A review of the history of Zr is presented. The following topics are covered: Klaproth's discovery of Zr in zirconia, reduction of its salts to liberate the metal, the iodide method of preparation, and application of its corrosion resistance and strength. (D.L.C.)

16021

SOME CHARACTERISTICS OF INTEGRON MILD STEEL TUBING FOR HEAT EXCHANGERS IN NUCLEAR POWER STATIONS. F. E. Asbury and L. H. Toft (Central Electricity Research Labs., London). Metallurgia 61, 193-200(1960) May.

Consequent upon the decision to use Integron mild steel tubing for the heat exchangers of the Berkeley and Bradwell nuclear power stations, the following aspects of the characteristics and behavior of this material were investigated: the general metallurgical characteristics and the fatigue resistance of the tubing in the "as-finned" and in the heat treated conditions; the effect of service temperature conditions on the tensile properties and residual stress; and the effect of welding on the parent material. The results of these investigations show that mild steel Integron tubing should be satisfactory for service without heat treating under the conditions proposed for the Bradwell and Berkeley heat exchangers. (auth)

16022

HIGH-TEMPERATURE CREEP OF GRAPHITE. D. B. Fischbach (California Inst. of Tech., Pasadena). Nature 186, 795-7(1960) June 4.

Short-time tensile creep data in the temperature-range 2,400 to 3,000°C were obtained for several commercial grades of synthetic graphite using test specimens with an 0.25-inch diameter by 1-inch long gage section. The data are presented graphically. Observations made on the creep recovery phenomena are also reported. (C.H.)

16023

MOSAIC TEXTURE OF GRAPHITES. E. G. Steward and B. P. Cook (General Electric Co., Ltd., Wembley, Eng.). Nature 186, 797-8(1960) June 4.

Recent studies of the graphitization process in anthracites, pyrolytic and evaporated carbons are discussed. The concept of larger mosaic units is considered. Results of x-ray diffraction studies are reported. It is concluded that x-ray diffraction has the unique ability to reveal the size of the basic crystalline unit in carbons, but further parameters need to be recognized when assessing the general crystalline texture of such materials and when considering their properties. (C.H.)

16024

THE STABILITY OF TUNGSTEN COMPARED WITH LIQUID CERIUM AND CERIUM—TUNGSTEN ALLOYS. Walter Obrowski (Metall-Laboratorium der DEGUSSA, Hannau am Main, Ger.). Naturwissenschaften 47, 201-2(1960). (In German)

Investigations showed that tungsten dissolved very rapidly in liquid Ce at 1000°C. Two intermetallic phases exist in Ce—W alloys. They are formed by peritectic reactions. The eutectic occurs near pure cerium. (J.S.R.)

16025
THE DENSITY OF LIQUID LEAD AND OF DILUTE SOLUTIONS OF NICKEL IN LEAD. S. W. Strauss, L. E. Richards, and B. F. Brown (U. S. Naval Research Lab., Washington, D. C.). Nuclear Sci. and Eng. 7, 442-7(1960) May.

The densities of liquid lead and of liquid nickel-lead solutions containing up to about 3.5 atomic per cent nickel were measured as a function of temperature using a modified Archimedean method. It was found that the densities of the nickel-lead solutions were greater than that of pure liquid lead and increased with increase in nickel content. Partial molal volumes for nickel and lead were then determined by the method of intercepts. The results indicate that for the composition region investigated the partial molal volume of lead does not differ significantly from the molal volume of lead and the partial molal volume of nickel approaches a value of zero at high dilution. (auth)

16026
AN INVESTIGATION OF MECHANICAL PROPERTIES OF METALS AT THE LIQUID-HELIUM TEMPERATURE. O. V. Klyavin and A. V. Stepanov (Physicotechnical Inst., Academy of Sciences, Leningrad). Soviet Phys.-Solid State 1, 1583-5(1960) May.

Initial results are presented of a systematic investigation of mechanical properties of solids, primarily metals and alloys, at temperatures close to absolute zero. At temperatures of 300, 78, 4.2, and 1.6°F, tensile stress-strain curves were obtained and mechanical strength was measured of Al, Pb, Cu, Ni, Ta, Ti, Cd, Armco iron, V-95 alloy, No. 3 steel, α-brass, and plexiglas. Some of these materials were tested in several states. (W.L.H.)

16027
ON THE TITANIUM CARBIDE REACTION WITH NICKEL. V. N. Eremenko and T. Ya. Kosolapova. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 3-6(1959). (In Ukrainian)

Metallographic studies and chemical phase analysis of carbon-free nickel with titanium carbide, prepared by powder metallurgy and treated under various thermal conditions, showed no separation of free carbon and indicated that the TiC—Ni system is quasi-binary. (R.V.J.)

16028
OXIDATION KINETICS AND MECHANISM OF TiC WITH ADMIXTURE OF Cr. V. N. Eremenko and Ya. V. Natanzon. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 7-17(1959). (In Ukrainian)

The oxidation kinetics of porous, hot-rolled TiC and the influence of small (up to 8%) chromium admixture on the oxidation rate were studied. (R.V.J.)

16029
INVESTIGATION OF ZrB—Mo ALLOYS. M. S. Koval'-chenko and G. V. Samsonov. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 18-24(1959). (In Ukrainian)

Metallographic, x-ray diffraction, and thermal analysis of hot-rolled ZrB—Mo alloys (5, 40, and 60 mole % Mo) show sufficiently dense material prepared under 260 kg/min^2 at 2000 to 2100°C. (R.V.J.)

16030
MODULUS OF ELASTICITY OF ALLOYS. P. I. Mel'-nichuk and I. N. Frantsevich. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 33-8(1959). (In Ukrainian)

Studies of the elastic modulus of Ni—W (up to 21.98% W) as a function of concentration show that additions of tungsten improve the interatomic bond strength in Ni lattices. (R.V.J.)

16031
REACTIONS OF Ti, Zr, AND W BORIDES WITH THEIR CARBIDES. G. V. Samsonov. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 72-98(1959). (In Ukrainian)

Metallographic, x-ray diffraction, and microhardness analyses of TiB—TiC, TiB_2—TiC, ZrB—ZrC, ZrC_2—ZrC, and W_2B_2 show continuous solid solution series of TiB—TiC and ZrB—ZrC. In the TiB_2—TiC system observations revealed TiB_2 and TiC diffusion (up to 20 mole %) and ion diffusion of TiC and TiB_2. In ZrB_2—ZrC and W_2B_5—WC, diffusion is practically absent. It is also shown that ternary compounds of Ti_2B_2C, W_2B_2C, etc., do not form in the examined systems. The microhardness of TiB and ZrB is 2700 to 2800 and 3500 to 3600 kg/mm^2, respectively. Pure W_2B_5 and W_2B_5 with 10 mole % WC showed the highest resistance to oxidation. (R.V.J.)

16032
THERMIONIC EMISSION PROPERTIES OF TRANSITION METALS AND THEIR COMPOUNDS WITH B, C, N, AND Li. G. V. Samsonov and V. S. Neshpor. Voprosy Poroshkovoĭ Met. i Prochnosti Materialov, Akad. Nauk Ukr. S.S.R. No. 7, 99-104(1959). (In Ukrainian)

The resistance of transition metals plotted as a function of the number of electrons in nonsaturated d-shells shows a reduced resistance of metals with increased d-shell quantum numbers and with increased numbers of electrons. The resistance (and consequently the electron scattering) is increased with increased ξ_d for groups IV to VI and varies very little for groups VII and VIII. Analogous phenomena are observed with the lanthanides with defective 4f shells. The magnitude ξ_f for this group is $\sqrt{1/Z_{4f}n}$, where Z is the number of electrons in the 4f shell. The formation of transition metal compounds with boron, carbon, nitrogen, and silicon results in changes of electron states in the initial metal crystals. However, certain regularities are noticed in the electrical properties of compounds due to the peculiar atomic structure of the components. (R.V.J.)

16033
OXIDES FOR HIGH-TEMPERATURE APPLICATIONS. W. D. Kingery (Massachusetts Inst. of Tech., Cambridge, Mass.). p.76-89 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Properties of oxides for high-temperature use are examined. Aspects of stability in rapid heating or mechanical impact are emphasized, and major consideration is given to materials obtained in single crystals or dense single-phase crystalline solids. Data on properties of these oxides are included. (J.R.D.)

16034
MECHANICAL PROPERTY BEHAVIOR OF METALS AT ELEVATED TEMPERATURES. Nicholas J. Grant (Massachusetts Inst. of Tech., Cambridge). p.198-211 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of the mechanical properties of metals at elevated temperatures is presented. Included are discussions of deformation and fracture, high-temperature testing, and control of high-temperature mechanical properties. (J.R.D.)

Radiation Effects

16035 AERE-R-3085

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SOME EFFECTS OF RADIATION IN CAST EPOXIDE RESIN SYSTEMS. I. D. Aitken and K. Ralph. Feb. 1960. 22p. BIS.

Changes in the flexural strength of cast epoxy resins due to pile irradiation were measured. The effect of various types of curing agent on the rate of breakdown is shown. (auth)

16036 AFOSR-TR-60-66

Turin. Istituto Elettrotecnico Nazionale Galileo Ferraris.

EFFECT OF NEUTRON BOMBARDMENT ON THE MAGNETIC PROPERTIES OF IRON AND NICKEL OF VERY HIGH PERMEABILITY. [PART] III. Final Report No. 3b. Giuseppe Biorci, Andrea Ferro, and Giorgio Montalenti. Feb. 1960. 66p. Contract AF61(514)-1331.

The effects of neutron bombardment on the magnetic properties of pure iron and nickel with permeabilities of 150 in iron and 5 in nickel were investigated. No outstanding variations in the magnetic properties of nickel were observed after irradiation. The iron samples show a marked increase of coercive force and a decrease of about 30% from maximum permeability. Theoretical interpretations of results led to the conclusion that irradiation also produces defects stable at room temperature whose size (or range of influence) are about, or larger than, 1000 A. (J.R.D.)

16037 AFOSR-TR-60-67

Turin. Istituto Elettrotecnico Nazionale Galileo Ferraris.

FINAL REPORT. PART A: GENERALIZATION OF THE THEORY OF THE ISOTHERMAL BLEACHING OF F-CENTERS IN X-RAYED ALKALI HALIDES. Guido Bonfiglioli, Piero Brovetto, and Cesare Cortese. PART B: ELECTRON MICROSCOPY EXAMINATION OF TRACKS OF FISSION PRODUCTS IN MICA CRYSTALS. Guido Bonfiglioli, Andrea Ferro, and Adriana Mojoni. Mar. 1960. 40p. Contract AF61(514)-1333.

A generalization of the theory of isothermal bleaching of F-centers in x-irradiated alkali halides is given. An electron microscope study of fission fragment tracks in mica crystals is reported. It is shown that the tracks are essentially cylindrical thermal spikes of a diameter consistent with theoretical estimates. The dashed aspect of some tracks is discussed and related to interference contrast effects or incipient annealing. (W.D.M.)

16038 ANL-5640

Argonne National Lab., Ill.

EFFECTS OF IRRADIATION ON SOME CORROSION-RESISTANT FUEL ALLOYS. J. H. Kittel and K. F. Smith. May 1960. 18p. Contract W-31-109-eng-38. OTS.

An investigation was made of the behavior under irradiation of uranium-rich corrosion-resistant alloys with the following nominal compositions: U−3 wt.% Nb, U−3 wt.% Nb−0.5 wt.% Sn, U_3Si (U−3.8 wt.% Si), and U−2 wt.% Zr (diffusion heat treated). The U−3 wt.% Nb alloy in the rolled and gamma-quenched condition was highly unstable dimensionally under irradiation. The U−3 wt.% Nb−0.5 wt.% Sn alloy, in the cast and gamma-quenched condition, was only moderately stable dimensionally. The U_3Si in the cast condition showed good dimensional stability but in the extruded condition developed moderate anisotropic growth. Clad rods of diffusion heat treated U−2 wt.% Zr alloy were generally highly stable. Only the U_3Si and U−2 wt.% Zr alloy specimens retained a significant degree of their pre-irradiation corrosion resistance. (auth)

16039 BC-43

California. Univ., Berkeley. Radiation Lab.

THE RECOVERY OF C^{14} FROM IRRADIATED BERYLLIUM NITRIDE. B. A. Fries. Mar. 7, 1947. Decl. May 3, 1960. 11p. Contract W-7405-Eng-48. OTS.

Methods for the recovery of C^{14} from neutron-irradiated Be_3N_2, based on solution in acid and alkali, are outlined. (C.J.G.)

16040 CNLM-1802-15

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

RADIATION EFFECTS ON ALUMINUM, ELASTOMERS, AND LUBRICANTS. A BIBLIOGRAPHY. Elizabeth A. Cernak, comp. Apr. 4, 1960. 27p. OTS.

A bibliography containing 145 references to radiation effects on aluminum, estastomers, and lubricants is presented. Also included are references on radiation units and conversion factors. The bibliography is limited to the period 1950 through 1959. Sources are listed. (J.R.D.)

16041 DP-420

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

QUANTITATIVE CORRELATION OF IRRADIATION GROWTH WITH PREFERRED ORIENTATION IN URANIUM. William R. McDonell. May 1960. 27p. Contract AT(07-2)-1. OTS.

A review is presented of the methods developed at the Savannah River Laboratory and elsewhere for quantitative correlation of irradiation growth with preferred orientation in uranium, with preferred orientation characterized by x-ray and dilatometric techniques. In an application of the methods, it is shown that a strongly oriented uranium plate, clad in aluminum, was much more stable in dimensions than would be expected from the observed dimensional behavior of either unrestrained single crystals of uranium or aluminum-clad polycrystalline rod. The greater stability of the plate is attributed to a relatively strong cladding and other restraining effects. (auth)

16042 HW-25412

[Hanford Works, Richland, Wash.].

IRRADIATION OF 63S ALUMINUM SAMPLES. P. D. Wright. Aug. 21, 1952. Decl. May 5, 1960. 10p. OTS.

Data obtained from testing and observing samples of 63S Al irradiated for approximately three months are presented. Tensile data show a slight, general increase in strength during pile exposure with a slight decrease in elongation. It is uncertain whether this increase in strength is a result of irradiation, exposure to slightly elevated temperatures, or a combination of the two effects. Metallographic examination revealed no apparent damage to the microstructure. As a result of these tests, it was determined that there is no damage in the 63S Al samples caused by irradiation. (auth)

16043 HW-46472

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

POST-IRRADIATION EXAMINATION OF CLUSTER-TYPE FUEL ELEMENTS. C. L. Boyd. Nov. 19, 1956. Decl. Mar. 16, 1960. 8p. OTS.

Satisfactory in-reactor performance of cluster-type fuel elements, containing unbonded, stainless steel clad natural uranium rods, to exposures of 110 Mwd/t was demonstrated on a limited scale. No evidence of dimensional instability or stainless steel−uranium interaction was observed. (auth)

16044 HW-61821

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FRETTING CORROSION IRRADIATION TESTS. M. K. Millhollen. Sept. 10, 1958. 9p. OTS.

Irradiations of wire wrapped PRTR type fuel rod clusters varying in length from 10 in. to 8 ft were conducted. Conditions were somewhat similar to those existing in PRTR. The irradiated fuel elements exhibited no evidence of fretting corrosion under these conditions. (J.R.D.)

16045 NAA-SR-124(Rev.)

North American Aviation, Inc., Downey, Calif.

A NEW ASPECT OF RADIATION DAMAGE: CHANGED GAS SORPTION PROPERTIES OF IRRADIATED GRAPHITE AND METALS. M. H. Feldman. July 18, 1951. Decl. Mar. 2, 1960. 25p. Contract AT-11-1-GEN-8. OTS.

A hitherto unreported effect of radiation on the gas sorption properties of graphite was observed, in the course of annealing experiments performed at NAA on Hanford-irradiated type AGOT graphite. Outgassing of otherwise comparable samples of such graphite, at a fixed, elevated temperature, was found to increase markedly as a result of previous irradiation history. A possible theoretical basis for the new effect is discussed. Experiments are outlined which can check and extend the present qualitative data. Implications for solids other than graphite, especially for metals, are presented; and several possible practical consequences of the effect are indicated. (auth)

16046 NAA-SR-Memo-1890

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

RADIATION DAMAGE TO NON-METALLIC MATERIALS. A Literature Survey. E. M. Doss. May 8, 1957. 16p. OTS.

Results of a radiation damage survey on effects of fast neutron and gamma radiation impact on non-metallic materials are presented. (J.R.D.)

16047 NP-8661

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

INDIRECT ABSORPTION EDGE IN GERMANIUM BOMBARDED BY FAST NEUTRONS. Report No. 126/I-B. W. Nazarewicz. Dec. 1959. 10p.

The results of infrared absorption measurements for germanium single crystals with various concentrations of structural defects introduced by fast neutron bombardment are reported. It was found that the edge is of the form expected for indirect transitions accompanied by phonon interaction. An analysis of absorption data on the basis of the Macfarlane-Roberts formula yields values for the indirect energy gap and the temperature of the phonon involved. Various concentrations of defects were obtained by partially annealing at various elevated temperatures. (auth)

16048 NP-8680

New York Univ., New York.

RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 8 for November, December [1959], and January [1960]. Hartmut Kallmann. Mar. 1960. 39p. Contract DA-36-039-SC-75043.

The various ways of energy transfer to fluorescent or quenching molecules from the bulk material are discussed. It is shown how energy transfer to a fluorescent solute can be determined from the results of quenching experiments especially at high solute concentration. An estimate is given of how fast energy can be transferred via migration. These considerations are applied to experiments in liquid and rigid solutions. The results with liquid solutes indicate that in these systems energy transfer goes via the diffusion and not via the migration process. From the comparison of quenching and energy transfer in rigid systems, it is concluded that in systems of polyvinylnaphthalene and of polystyrene containing considerable amounts of naphthalene energy transfer to a fluorescent solute occurs via jumps over several atomic distances. The considerable quenching observed in polystyrene systems, however, indicates that in polystyrene without naphthalene energy also is transferred via migration. The behavior of two differently activated ZnS phosphors (Cu, Cu-Pb) under band-band-excitation and activator excitation is studied. The correlation of luminescence and conductivity gives interesting results, especially under simultaneous IR irradiation. In most cases, when the luminescence increases by the action of IR, the conductivity decreases. This is surprising since an increase in the luminescence intensity was always considered to be due to an increase of electrons in the conduction band. The decrease in conductivity and increase in luminescence, however, can be understood by assuming that the IR shifts holes to more efficient activators, thereby increasing the light emission while the number of free electrons is decreased. (See also NP-7750.) (auth)

16049 OOR-719.17

Bartol Research Foundation, Swarthmore, Penna.

EMISSION OF ELECTRONS FROM METALS AND INDUCTION OF ELECTRICAL CONDUCTION IN CRYSTALS, RESULTING FROM ELECTRON BOMBARDMENT. Final Report. Martin A. Pomerantz. Mar. 31, 1960. 61p. DA Project No. 5B99-01-004. Contract DA-36-034-ORD-1846.

Investigations of the transitions resulting from the passage of high-energy electrons through non-conducting crystals yield basic information regarding the physics of solids. The bombardment-induced phenomena which were investigated include electrical conductivity both during and after bombardment, photoconductivity, and optical absorption. Some of the properties of solids investigated were energy level schemes, densities of trapping centers, and mobility of charge carriers. (auth)

16050 HW-tr-13

ABSORPTION SPECTRUM AND THERMOLUMINESCENCE CURVE OF FUSED QUARTZ IRRADIATED BY X- AND γ-RAYS. M. Lautout. Translated by Liz Appleby (Hanford Atomic Products Operation) from J. chim. phys. 52, 259-66(1955). 22p. JCL.

The absorption spectrum bands of fused quartz at 5500, 3700, 3000, and 2220A irradiated by x rays or gamma radiation were related to the emission maximum of the thermoluminescence curve. (J.R.D.)

16051

INTERNAL ENERGY AND ELASTIC CONSTANTS FOR SILICON IRRADIATED WITH FAST NEUTRONS. Guy Mayer and Marcel Lecomte (Centre d'Études Nucléaires, Saclay, France). J. phys. radium 21, 242-8(1960) Apr. (In French)

Silicon monocrystals were pile irradiated with doses of up to 3.7×10^{19} fast neutrons per cm^2. The internal energy and the elastic properties were measured at various stages of the irradiation. The influence of heat treatment on these properties was then investigated. Using the numerical values thus obtained an attempt is made to determine the nature and number of defects induced in these crystals by fast neutrons. (auth)

16052

RADIATION EFFECTS ON MAGNETIC PROPERTIES OF FERRITE. N. M. Omel'yanovskaya (Omel'janovskaja). Kernenergie 3, 394-6(1960) Apr. (In German)

Changes in one parameter of a hysteresis loop were studied by a special pulse-operated apparatus. Pulses from a square-wave generator ($\pm I$, $+K$, $-I_{HE}$) are fed to a primary ferrite coil. The half-excitation current I_{HE}, 60% of the total current, induces a small interference potential (A_{HE}) in the secondary coil. The more rectangular the hysteresis loop is, the smaller A_{HE} is. Thus one can exclude changes in I_{HE} by the slope changes of the horizontal part of the hysteresis loop. Radiation effects were studied by using ferrite irradiated to integral doses of 2.15 and 6.5×10^{17} n/cm^2 at 1.5×10^{13} n/cm^2 sec. The results are tabulated and discussed. (T.R.H.)

16053

ELECTRON SPIN RESONANCE OF SOME γ-IRRADIATED POLYMERS. Kenzi Hukuda. Mem. Fac. Sci., Kyushu Univ. Ser. B 3, No. 1, 41-51(1960) Mar. (In English)

The electron spin resonances of free radicals produced in the γ-irradiated long chain polymers such as polyvinyl chloride, copolymer of vinylidene chloride and vinyl chloride, polytetrafluoroethylene, and polymethyl methacrylate were observed mainly at 3cm wavelength and partially at 8mm wavelength. The rates of production and extinction of radicals in the polymers are discussed and the hyperfine structure of the spectrum of polymethyl methacrylate is shown not to support the model of bi-radical for the magnetic center. (auth)

16054

THE USE OF AN IONIC BOMBARDMENT DEVICE WITH FOCUSED BEAMS IN THE STUDY OF METALS. M. Azam (Centre d'Etudes Nucléaires, Saclay, France). Mém. sci. rev. mét. 57, 41-8(1960) Jan. (In French)

An apparatus is described which is very quickly put into service and very simple in construction which enables one to obtain ionic beams of predetermined form. Some results obtained in various applications (cleaning up of surfaces, metallic structure determinations, destruction of oxide films, etc.) are presented and discussed. (auth)

16055

RADIATION VULCANIZATION OF ELASTOMERS. ATOMIC ACCELERATORS AND REACTORS PROMISE HIGH TEMPERATURE STRESS-STRAIN PROPERTIES. Dale J. Harmon (B. F. Goodrich Co., Brecksville, Ohio). Rubber Age 86, 251-61(1959) Nov.

The physical properties of radiation vulcanizates were studied and compared with corresponding measurements on chemical vulcanizates. The chemically cured specimens were known to have good age resistance. The recipes for radiation vulcanization consisted of the polymer and the same amount of reinforcing agent as used in the comparison specimen. The procedures used in the test program are discussed. It is estimated that the cost for radiation vulcanization is a factor of 10 higher than the conventional method. (B.O.G.)

16056

EFFECTS OF X-IRRADIATION ON THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF FERROELECTRIC TRIGLYCINE SULFATE. D. M. Dodd (Bell Telephone Labs., Inc., Murray Hill, N. J.). Spectrochim. Acta 16, 413-18(1960) May.

After a dosage of only 1×10^5 r, a weak absorption band is seen at 255 mμ in the near ultraviolet spectrum of crystalline triglycine sulfate (TGS). The intensity of this band increases with x-ray treatment until, after a total dosage of about 3×10^6 r, it is so strong that the ultraviolet cutoff is effectively shifted from the original 255 mμ (5.5 ev) position to around 293 mμ (4.2 ev). Because the change decays neither with time at room temperature nor with the application of heat, it must be of a chemical nature and not due to color centers. The gaseous x-ray decomposition products of crystalline TGS are found to be SO_2, CO_2, and H_2, but these are not responsible for the 255 mμ absorption band. The relative amounts of the gaseous products indicate that x-rays cause decarboxylation of some of the glycine units and disintegration of a smaller proportion of the sulfate groups. The effects of x-irradiation on crystalline glycine are quite different from those on crystalline TGS. (auth)

16057

THE INFLUENCE OF IONIZING RADIATION ON THE CHANGES IN SODIUM–BUTADIENE RUBBER. M. A. Salimov, E. V. Zhuravskaya, and A. S. Kuz'minskii. Vestnik Moskov. Univ. Ser. Mat., Mekhan., Astron., Fiz. i Khim. 3, 177-83(1959). (In Russian)

The changes in sodium butadiene rubber (with 2% antioxidant-phenyl-β-naphthylamine and also without) exposed to x radiation at 5×10^6 r/h in air and in nitrogen were studied by infrared spectroscopy. The observations indicated strong molecular structure changes: alterations in the double bond concentrations, chain branching, and oxidation followed by accumulation of various oxygen-containing products. (R.V.J.)

16058

CAUSING COLOUR CHANGES IN POLYMER PLASTICS BY IRRADIATION. Solomon Harris Pinner and Albert John Swallow (to T. I. (Group Services), Ltd.). British Patent 835,120. May 18, 1960.

An irradiation procedure is given for coloring plastics which contain Cl. The irradiation causes color changes, and passes through several thicknesses of plastic or even through a package. Patterns and designs can be used. By controlling composition and irradiation desired colors and shades are produced. (T.R.H.)

PHYSICS

General and Miscellaneous

16059 A/AC.82/R.78

United Nations. Scientific Committee on the Effects of Atomic Radiation.

BIBLIOGRAPHY OF PAPERS RELATING TO THE CARBON CYCLE IN NATURE AND RADIOCARBON FROM NUCLEAR TESTS. Dec. 7, 1959. 7p.

A bibliography containing 91 references to papers on the carbon cycle in nature and radiocarbon from nuclear tests is given. (W.D.M.)

16060 AD-212714

Pavia, Italy. Universitá. Istituto di Fisica Superiore.

A METHOD FOR THE MEASUREMENT OF THE NUCLEAR TRANSVERSAL RELAXATION TIME. Final Technical Report No. 1 for February 1958–January 1959. G. Bonera, L. Chiodi, L. Giulotto, and G. Lanzi. Feb. 1959. 49p. Contract DA-91-508-EUC-278.

A method for measuring transverse relaxation times in liquids is described. The method is based on the observation of the decay of the nuclear magnetization when it precesses in a plane perpendicular to the constant magnetic field. This condition is realized by stopping the variation

of the constant magnetic field during a fast adiabatic passage at a proper time. The constant magnetic field is modulated with a saw-tooth current from a relaxation oscillator and an amplifier. When the voltage induced by the nuclear precession reaches a fixed value the relaxation oscillator is stopped with a delay such that the constant field stops its variation at the value for which the signal has the largest amplitude. Measurements were made on some liquids and the preliminary results indicate that the values of T_2 are very close to those of T_1. (auth)

16061 AFOSR-TN-60-308
Hebrew Univ., Jerusalem.
PARAMAGNETIC AND OPTICAL SPECTRA OF YTTERBIUM IN THE CUBIC FIELD OF CALCIUM FLUORIDE. Technical Note No. 11. W. Low. Jan. 1960. 8p.

The paramagnetic resonance spectrum of Yb^{3+} in CaF_2 was observed at 20°K and 3 cms wavelength. The spectrum is described by a cubic spin Hamiltonian $\mathcal{H} = g\beta H \cdot S + AS \cdot I$ with $g = 3.426 \pm 0.001$, $S = \frac{1}{2}$, $A^{171} = 886.5 \pm 1.5 \times 10^{-4}$ cm^{-1}, $A^{173} = 243.2 \pm 0.4 \times 10^{-4}$ cm^{-1}, $I^{171} = \frac{1}{2}$, $I^{173} = \frac{5}{2}$. The ratio of magnetic moments is $\mu^{173}/\mu^{171} = 1.374_9 \pm 0.005$. The optical spectrum shows lines of 9774, 9770, 9763 A^0, and more diffuse and unresolved bands at 9080 and 12730 A^0. The paramagnetic spectrum is explained as arising from the Γ_7 doublet. The other levels are removed by at least a few cm^{-1} leading to an isotropic g value of 3 or $^{24}/_{7}$ for the lowest Γ_7 level. (auth)

16062 AFOSR-TN-60-426
Aerojet-General Corp., Azusa, Calif.
A SEARCH FOR THE IONIZATION OF H_2 ON DIFFUSION THROUGH Pd. J. R. Radbill and R. J. Sunderland. Feb. 1960. 20p. Contract AF49(638)-214. (TN-34).

Ionization of hydrogen through palladium was investigated. Using as a source a 0.005-in. palladium foil maintained at 1000°K, the mass spectrum of the emission was determined, with and without the diffusion of hydrogen. Ions corresponding to singly charged Na^{23}, K^{39}, and K^{41} were detected with the Na^{23} mass peak predominating. No other ions were found within the mass range capability (1-240 amu) of the magnetic fields used. Results indicate that the individual ion current densities at the emitter, due to thermally ionized hydrogen atoms or molecules, must be less than 10^{-9} amp/cm^2. (auth)

16063 AFOSR-TN-60-435
Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
QUANTUM STATISTICAL PAIR DISTRIBUTION FUNCTION; GENERAL THEORY AND ITS APPLICATION TO THE ELECTRON GAS (thesis). Shigeji Fujita. Mar. 1960. 92p. Contract AF18(600)-1315. (BN-204).

A general theory for calculating the pair distribution function for a quantum statistical system is developed and applied to the electron gas. A cluster integral expansion for the pair distribution function of both quantum and classical systems is derived. Each cluster integral is represented by a hybrid (toron diagram) between a Mayer graph and a Feynman diagram in position-reciprocal temperature space. Analysis of diagrams leads to a theorem that the pair distribution function in grand canonical ensemble can be expressed in terms of two-body propagators. Various techniques, which were originally devised for the quantum field theory, are used for the analysis. In particular, the modified interaction is introduced as a partial sum of certain subdiagrams. It is shown that the simple chain approximation to the modified interaction is responsible for the transfer of a plasmon in the case of low temperature electron gas. The pair distribution function up to the first order in the modified interaction is calculated. A new expression which relates the internal energy with the pair distribution function is derived, assuming a system of many particles interacting through pair forces. This is used to calculate the ground-state energy of an electron gas. The result is in agreement with the work of Gell-Mann Bruckner. (auth)

16064 AFOSR-TR-59-203
Israel Inst. of Tech., Haifa and Stanford Univ., Calif.
BUCKLING OF CONICAL SHELLS UNDER EXTERNAL PRESSURE AND THERMAL STRESSES. Technical Final Report. Josef Singer and Nicholas J. Hoff. Dec. 1959. 83p. Contract AF61(052)-123.

Simplified differential equations governing the deformations of thin circular conical shells subjected to arbitrary loads and arbitrary temperature distributions are derived by the principle of the minimum total energy. The equations reduce to Donnell's expressions when the cone angle approaches zero. The same method of solution with slightly relaxed boundary conditions for the non-dimensional displacement along a generator, and the non-dimensional circumferential displacement, is then applied to the thermal buckling problem of truncated conical shells subjected to axisymmetrical temperature distributions. A typical example is analyzed. The equations are also extended to include problems of elastic stability. (J.R.D.)

16065 AFOSR-TR-60-50
Ohio State Univ. Research Foundation, Columbus.
THE ANALYSIS AND PRODUCTION OF DENSE ELECTRON BEAMS FOR USE IN MICROWAVE TUBES. Final Report. R. M. Campbell. Mar. 1960. 104p. RF Project 580. Contract AF18(600)-980. OTS.

The object of the research was to find a means of studying and producing dense electron beams. To achieve the desired results, several mathematical methods of analysis were studied and a pinhole-camera gun tester was built. Of the mathematical methods studied, a relaxation method in conjunction with a resistance analog network appeared to be the most useful. A paraboloidal-spheroidal gun, a nonconfocal spheroidal gun, and a modified Heil gun were analyzed mathematically using the relaxation method. This method was also used to study the space-charge-limited potential distribution in spheroidal and paraboloidal diodes. A toroidal gun capable of high perveance but with resulting low convergence was studied using a gun tester. The pinhole-camera gun tester was utilized to study the paraboloidal-spheroidal gun, the nonconfocal spheroidal gun, the modified Heil gun, and a spherical cathode gun. Current density distributions in the beams, and in some instances transverse velocity distributions, were measured. In all cases, the measurements were made for a range of cold cathode-to-anode spacings. These data are presented in detail and are intended as a guide in the design and utilization of these and similar electron guns. (auth)

16066 APEX-552
General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
FINITE CYLINDER GAMMA HEATING PROGRAM (MONTE CARLO RESEARCH SERIES). J. R. Beeler and A. H. Barnett. May 1958. 18p. Contracts [AF]33(600)-38062 and AT(11-1)-171. OTS.

The IBM 704 program described computes the heat source density in a finite homogeneous cylinder due to photon energy degradation, given an arbitrary photon source in space and energy. The output is a gross radial and gross longitudinal histogram together with a listing of the

heat source density in each of up to 400 disjoint volumes bounded by toroidal surfaces. (auth)

16067 CAL-AD-1118-A-9

Cornell Aeronautical Lab., Inc., Buffalo.

PRELIMINARY RESEARCH ON A MOLECULAR BEAM FOR THE 1-10 ev RANGE. G. T. Skinner and C. E. Treanor. Dec. 1959. 66p. Contract AF18(603)-141. (AFOSR-TN-59-1086).

The design and construction of a molecular-beam apparatus for the production of atomic and molecular beams in the 1 to 10 ev energy range are discussed. A shock tube is used as the source of high-temperature, high-pressure gas, and a hypersonic expansion is used to obtain a high-energy, nearly mono-energetic beam. Use of a two-center potential for the treatment of atom-molecule collisions is discussed. (auth)

16068 CU(PNPL)-199

Columbia Univ., New York. Pegram Nuclear Physics Labs.

PROGRESS REPORT FOR JULY, AUGUST, SEPTEMBER 1959 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 50p. Contract AT-30-1-GEN-72. OTS.

Neutron data were obtained for Th, Au, and Nb in the energy region below a few kev. Transmission measurements employing the B^{10}-NaI flat detector were carried out for all three materials. Self-detection capture gamma ray data were taken for Au and Nb. Several additions and modifications were made to the velocity selector spectrometer. A gas scintillation counter combining He^3 and Xe was tested. For the precision measurement of the (n,p) cross section, advances were made by using electrostatic lenses to focus the Van de Graaff beam. The absolute value of the total neutron cross section of U^{235} was measured for neutrons of energies between 0.00818 and 0.0818 ev. The installation and testing of the automatic arm advance mechanism were completed. Preliminary measurements of the subthermal neutron cross section of powdered MnF_2, MnO, and ZnF_2 were completed. An external beam of ~10 μa of 13 Mev protons was obtained from the exit valve window of the cyclotron chamber. Angular distributions were obtained for the reaction $F^{19}(d,n)Ne^{20}$. The search for the reported 1.47 Mev level in Na^{21} from the $Ne^{20}(p,\gamma)$ reaction was continued. The study of the relative strengths of the $0^+ \rightarrow 0^+$ decay modes through double gamma transition, pair production, and internal conversion was extended to Zr^{90} and Ge^{72}. A new resonance was observed in the reaction $C^{12}(p,p\gamma)$. The He^3 beam of energies between 2.5 and 3.5 Mev was put into operation. The double focusing magnetic spectrometer is being used for study of the inelastic proton scattering on Mg^{25}. A general formula for the muon capture reaction and the transition rate for the forbidden transition were calculated. Instrument development is summarized. The investigation of the v/c dependence in β-γ correlation was completed. For the He^6 beta-neutrino angular correlation experiment, two different, well-type "Pilot-B" scintillation spectrometers were designed, constructed, and tested. In connection with the program of measurement of short life-times of excited nuclear states, a fast coincidence spectrometer was developed. (For preceding period see CU-194.) (W.D.M.)

16069 GA-380 and App.I-IV

General Atomic Div., General Dynamics Corp., San Diego, Calif.

NEUTRON THERMAL INELASTIC SCATTERING AND THERMALIZATION. Technical Status Report through May 31, 1958. July 25, 1958. Appendix I: NEUTRON THERMALIZATION BY CHEMICALLY BOUND HYDROGEN AND CARBON. A. W. McReynolds, M. S. Nelkin, M. N. Rosenbluth, and W. L. Whittemore. (A/CONF.15/P/1540 and Add.; GA-349 and Add.). Appendix II: A TIME-OF-FLIGHT STUDY OF NEUTRON THERMALIZATION. W. L. Whittemore, I. Pelah, and A. W. McReynolds. July 10, 1958. (GA-409). Appendix III: NEUTRON INVESTIGATION OF OPTICAL VIBRATION LEVELS IN ZIRCONIUM HYDRIDE. A. Andresen, A. W. McReynolds, M. S. Nelkin, W. N. Rosenbluth, and W. L. Whittemore. Phys. Rev. 108, 1092-3(1957). Appendix IV: THE TOTAL NEUTRON CROSS SECTION AS A FUNCTION OF ENERGY FOR ZIRCONIUM HYDRIDE, WATER AND MAGNESIUM HYDRIDE. William L. Whittemore. 75p. Contract AT(04-3)-167, Project No. I. OTS.

A/CONF.15/P/1540 previously abstracted as NSA Vol. 12, abstract No. 14952; Appendix III previously abstracted as NSA Vol. 12, abstract No. 3007.

A review is presented of the experimental methods employed in studying the angular and energy distribution of neutrons after a single scattering. These distributions were studied as functions of the incident energy and various moderator temperatures and interpreted in terms of molecular and lattice dynamics. Neutron thermalization by chemically bound hydrogen and carbon was studied. The total neutron cross section was determined as a function of energy for zirconium hydride, water, and magnesium hydride. A time-of-flight study of neutron thermalization was made. (C.J.G.)

16070 GAT-T-802

Goodyear Atomic Corp., Portsmouth, Ohio.

A PROCEDURE FOR BLENDING INACCURATELY KNOWN BASES TO MATCH A U^{235} ISOTOPIC STANDARD. R. L. Smith. May 3, 1960. 12p. Contract AT(33-2)-1. OTS.

A procedure is derived and evaluated that affords accurate mix proportions for blending inaccurately known bases to match the U^{235} content of an isotopic standard. The mix proportions are a function of the ratio of differences of U^{235} mol ratios, found by interpolative mass spectrometer determinations and the isotopic range of the bases. Matching U^{235} isotopic values to at least one part in ten thousand should be easily attainable. (auth)

16071 LA-174

Los Alamos Scientific Lab., N. Mex.

THE SPHERICAL-HARMONIC METHOD AND ITS APPLICATION TO ONE VELOCITY NEUTRON PROBLEMS. R. J. Glauber. Nov. 25, 1944. Decl. Apr. 27, 1960. 42p. Contract [W-7405-eng-36]. OTS.

A form of the spherical-harmonic method is shown to solve the one-velocity Boltzmann equation in plane or spherical cases to any desired degree of accuracy. Graphs are presented which show the radii of the U^{235} and Pu^{239} cores surrounded by infinite tampers for a wide range of multiplication numbers and ratios of tamper cross sections to core cross sections. (R.V.J.)

16072 LA-2344

Los Alamos Scientific Lab., N. Mex.

THE PRODUCTION OF IONS AT METALLIC SURFACES BOMBARDED BY ENERGETIC IONS. W. T. Leland and Roy Olson. Dec. 1959. 81p. Contract W-7405-eng-36. OTS.

A study was made as to the quantity and quality of charged particles produced at metallic surfaces bombarded by various ions with energies ranging from 25 to 200 kev. The metallic surfaces used were "typical" of most laboratory vacuum apparatus as opposed to absolutely clean surfaces. The measurements include the effects of primary current density, residual pressure, electric field. primary

ion energy, type of primary ion, and temperature of surface. The results are discussed relative to the vacuum breakdown problem. (auth)

16073 LA-2380
Los Alamos Scientific Lab., N. Mex.
A STATISTICAL TECHNIQUE FOR PREDICTING A TWO DIMENSIONAL VECTOR WITH APPLICATION. Richard E. Vogel. Feb. 1960. 91p. Contract W-7405-eng-36. OTS.

The problem of multiple regression analysis where the dependent and independent variables are components of a two dimensional vector is discussed, and a complete statistical development of the solution of estimators for the parameters in the model is given. The theory regarding predictions and confidence statements about such predictions is also developed. A computer code was written for the IBM 704 computer which solves the above problem and a description of the code is given. The statistical model was applied to a meteorological problem in wind forecasting at the Eniwetok Proving Ground, and prediction equations were developed and evaluated. (auth)

16074 LA-2394
Los Alamos Scientific Lab., N. Mex.
THE THERMAL EXPANSION OF PLUTONIUM METAL BELOW 300°K. T. A. Sandenaw. Feb. 1960. 23p. Contract W-7405-eng-36. OTS.

Curves for linear expansion of plutonium metal as a function of temperature below 300°K are shown for different cooling and heating cycles and for different purity. Hysteresis and time effects were found to be appreciable. The linear expansion curve obtained with very slow cooling or very slow warming rates appears to confirm the presence of two of the three major heat capacity peaks found in the temperature range below 160°K. Evidence for existence of an antiferromagnetic state in plutonium seems to be provided. A curve for the linear expansion of oxygen-free, high conductivity copper below 300°K is also given. (auth)

16075 NP-8689
Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
EFFECT OF MONO- AND TRIVALENT CATIONS ON COLOR CENTERS IN CALCIUM FLUORIDE. Technical Report 147. William J. Scouler. Apr. 1960. 30p. Contract Nonr-1841(50).

Coloration of pure CaF_2 crystals with 2.5-Mev electrons at room temperature gives four bands located at 580, 400, 335, and 225 mμ. Low-temperature (−190°C) coloration, however, yields different bands, located at 545, 320, and 275 mμ. In YF_3-doped crystals the bands are in the same spectral positions as in pure crystals. They are, however, enhanced, and at room temperature their intensity ratios are significantly changed, the 400-mμ band being predominant. NaF-doped crystals show an even more drastic change. Coloration at room temperature produces bands at 605, 385, and 330 mμ, while coloration at −190°C yields bands at 440, 390, 315, and 200 mμ. The coloration in NaF-doped crystals is deeper than in either pure or YF_3-doped crystals. Several explanations for the modification of the color-center spectra by doping are possible: in YF_3-doped crystals, interstitial F^- ions may act as a source of electrons and holes and/or induce vacancy formation through lattice distortion; and in NaF-doped crystals, F^- vacancies may act as traps and/or enhance oxygen contamination by diffusion. (auth)

16076 NP-8691
Texas. Univ., Austin.
RELAXATION PROCESSES IN LIQUIDS AND SOLIDS. Final Report [for] February 1, 1954–January 31, 1960. A. W. Nolle. Apr. 1, 1960. 44p. Contract Nonr-375(05).

A summary of research on the general topic of relaxation processes in liquids and solids is presented. Magnetic resonance relaxation was investigated, and in other work, relaxation processes in ultrasonic-wave absorption were studied. Experimental results led to information concerning thermally activated molecular processes in high polymers in molecular liquids, in aqueous solutions with paramagnetic ions, and in crystalline solids. (J.R.D.)

16077 NP-8692
Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
PRESSURE DEPENDENCE OF THE NÉEL TEMPERATURE IN CoO AND NiO, MEASURED WITH A NEW DILATOMETER. Technical Report No. 150. Theodore P. Janusz. Apr. 1960. 32p. Contract Nonr-1841(10).

A high-pressure dilatometer employing a gaseous pressure medium was developed to measure, over a range of pressures and temperatures, the change in sample length that occurs in many solid-state phase transformations. The device employs a differential transformer as length detector. The system at present covers a temperature range of −40 to +275°C and a pressure range up to 10,000 atmospheres. With a low-temperature cryostat the temperature range may be extended downward. As an application of the new device, the pressure dependence of the Néel temperature was measured for $CoO[(dT_N/dP) = (0.63 \pm 0.1) \times 10^{-3}$ deg/atm] and $NiO[(dT_N/dP) < 2 \times 10^{-3}$ deg/atm]. (auth)

16078 NYO-2702
Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.
STUDY OF SLIGHTLY-ENRICHED URANIUM–WATER LATTICES WITH HIGH CONVERSION RATIO. Quarterly Progress Report [for] August 1, 1959 to October 31, 1959. May 1960. 62p. Contract AT(30-1)-2379. OTS.

The work on undermoderated U–H_2O lattices was largely involved with calculations of the conversion characteristics of slightly enriched U metal fuel over a wide range of H_2O/U volume ratios and a continuation of theoretical work on resonance capture. Initial calculations for the U–H_2O lattices showed a considerable drop in the η of U^{235} as the enrichment of the lattice was increased and the water content decreased. However, when the effect of U^{238} fissions was included, the trend was reversed so that the "effective" η of U^{235} was found to increase as the H_2O/U ratio decreased. Considerable effort was applied to the problem of resonance absorption since those lattices which show unusually high conversion ratios are also those in which a very large fraction of the neutrons are absorbed in the resonance region. Two questions were studied; the intercomparison of theoretical results predicted by the various techniques now available for the calculation or resonance absorption and the degree of agreement which can be obtained between these results and available experimental information. On the basis of the work done so far, it is now possible to evaluate the resonance self-shielding effects not only in U^{238} but also for capture and fission in U^{235} and the various Pu isotopes for that part of the resonance structure which has been explored. (For preceding period see NYO-2701.) (W.D.M.)

16079 ORO-270
Maryland. Univ., College Park.
SINGLE-PARTICLE EXCITATIONS OF A DEGENERATE ELECTRON GAS. Technical Report No. 161. Arnold J.

Glick and Richard A. Ferrell. Dec. 1959. 35p. Contracts AT(40-1)-2098 and Nonr-1797(00). OTS.

The continuum of single-electron excitations determines the properties of the degenerate electron gas and, hence, also many properties of metals. Lindhard's frequency and wave number dependent dielectric constant for the electron gas is rederived by considering only these excitations. Collective screening, and thus plasma effects, are then automatically taken into account by means of the Kramers-Kronig relations which the dielectric constant satisfies. Experiments on inelastic scattering by metal films have revealed the collective plasma excitation but have not given much information about the actual band structure and single-electron excitations in a metal. Study of the plasmon can at best only give some of the moments of the single-particle spectrum. Using the dielectric theory as a guide, an experiment is suggested to gain information about the continuum directly. The most favorable scattering angle for studying the single-particle excitations is found to be just beyond the plasmon cut-off. (auth)

16080 RM-2328(RAND)
RAND Corp., Santa Monica, Calif.
ADDITIONAL VALUES FOR THE EQUILIBRIUM COMPOSITION AND THERMODYNAMIC PROPERTIES OF AIR. F. R. Gilmore. Dec. 30, 1959. 19p.

Supplementing RM-1543, values of the equilibrium composition and thermodynamic properties of air are presented at 10,000 and 50,000°K. The pure ideal-gas properties needed for these calculations are included. Equilibrium values for the principal charged particles at 1000 and 2000°K, and for the CN molecule between 1000 and 8000°K are also listed. Finally, the thermodynamic properties of air between 1000 and 10,000°K at 10 to 316 times standard density are tabulated. These properties are calculated to include approximate corrections for the intermolecular interactions. (auth)

16081 RMD-1155-S2
Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.
HEAVY PARTICLE PROPULSION RESEARCH. Period [covered]: July 1, 1959 to December 31, 1959. Raymond E. Wiech, Jr. 67p. Project RMD-1155. Contract AF49(638)-657. (AFOSR-TR-60-48).

The precontractual work reported was primarily concerned with the generation of charged heavy particles from the liquid state. Various particle generator cells were tried, all of which performed the dual operation of charge and spray. The experimental work in the second half of 1959 was limited to the generation of charged heavy particles from the solid state. The general problems of particle charging mechanisms and the effect of charge-to-mass ratio distribution upon powerplant performance were theoretically investigated. Based upon theoretical conclusions, an experimental steady flow unit was constructed. The purpose of this unit is to supply numerical information about several theoretical parameters. This unit has a maximum accelerating voltage of only 120 kv, with a maximum power of about 600 watts. From present results, this voltage is approximately 5% of the accelerating potential required for an operational system. The approximate characteristics of the research unit are: mass flow rate ≐ 1 milligram/sec, thrust ≐ 50 to 150 dynes (voltage sensitive) performance ≐ 100 sec (voltage sensitive), and a propellant of iron powder (300 A mean diameter). It must be emphasized that the above values are preliminary and all vary greatly. (auth)

16082 SCR-172
Sandia Corp., Albuquerque, N. Mex.
RADIO-FREQUENCY ATTENUATION MEASUREMENTS ON HIGH ALTITUDE NUCLEAR DETONATIONS. J. L. Dossey. Apr. 1960. 12p. OTS.

Several missile systems depend upon radiofrequency transmission for guidance. The effects which very high altitude nuclear detonations might have on such transmission are explored. A system of measurement used to investigate the phenomena during a series of full-scale nuclear tests is described. Deacon-Arrow II two-stage missiles with nose cones containing transmitters operating at either 225 or 1500 mc were positioned approximately throughout the atmosphere containing a nuclear explosion. Signals received, normalized to the curve representing free-space attenuation as a function of distance, were a measure of attenuation due to ionization vs. time and position. (auth)

16083 SCTM-12-56(51)
Sandia Corp., Albuquerque, N. Mex.
NOTES ON MINIMUM ENERGY TRAJECTORIES. D. R. Morrison. Jan. 17, 1956. 7p. OTS.

Methods are developed for plotting minimum energy free-fall trajectories between two points on the earth's surface and for determining the altitude above the surface at the midpoint of the trajectory. (auth)

16084 SCTM-53-60(14)
Sandia Corp., Albuquerque, N. Mex.
APPROXIMATE SOLUTION OF THE FREE SPACE ANTENNA EQUATION BASED ON A DETERMINATION OF THE COMPLEX COEFFICIENTS OF THE LEADING COMPONENTS OF THE CURRENT. Charles W. Harrison, Jr. Feb. 1, 1960. 12p. OTS.

The free space antenna equation is solved for the current and the driving point impedance by means of a technique that achieves sufficiently high accuracy in the leading terms of an iteration procedure so that higher-order terms do not have to be evaluated. The leading terms consist only of trigonometric functions with complex coefficients. The purpose is to establish a technique which may be employed with confidence in antenna research to solve a variety of problems directed at obtaining the impedance of combinations of linear radiators. The method is currently being applied to determine the impedance of an electrically short antenna in a conducting dielectric, and of a dipole immersed in salt water. (auth)

16085 SCTM-80-54(51)
Sandia Corp., Albuquerque, N. Mex.
MAXIMUM TEMPERATURE PATTERNS IN HOT CLIMATES. C. R. McAllister. June 4, 1954. 9p. OTS.

Maximum temperature patterns are presented for hot climates based on observed data. The importance of considering both climatological and synoptic, or day-to-day patterns in establishing temperature patterns is stressed. The role of temperature patterns in the prediction of useful storage life for batteries is discussed. (C.H.)

16086 TID-5884
Los Alamos Scientific Lab., N. Mex.
DETECTION FROM A SATELLITE OF NUCLEAR EXPLOSIONS IN SPACE BY MEANS OF AIR FLUORESCENCE IN THE UPPER ATMOSPHERE. E. W. Bennett. Oct. 19, 1959. 9p. Contract W-7405-Eng-36. OTS.

The possibility of using satellite systems equipped to detect air fluorescence induced by x rays as a means of detecting nuclear tests is discussed from the point of view of signal strength, signal rise time, background noise, and

elimination of "blind spots" in a ground based system. Two satellite systems are considered: a "near" system orbiting at an altitude of 500 KM and a "far" system at an altitude of 30,000 KM. The maximum range of detection for nuclear explosions occurring in space is found to be much less for either satellite system than for a ground based fluorescence observation system. However, explosions occurring at altitudes below 500 KM with as little as 1 KT x-ray yield can be detected by either satellite system, thus making possible the elimination of blind spots in the proposed ground based system which extend to 400 KM altitude. Complete coverage of the earth's surface is provided by 4 or 5 satellites in the far system or by approximately 40 in the near system. (auth)

16087 TID-5904

Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown.
BENDING OF A THIN CYLINDRICAL SHELL SUBJECTED TO A LINE LOAD AROUND A CIRCUMFERENCE. H. R. Meck. [June 1959]. 25p. Contract [AT(11-1)-229]. OTS.

An analysis is developed for bending of a thin circular cylindrical shell under a varying line load distributed around the circumference at the center section. The problem is solved by reducing the eighth order differential equation of thin shell theory to two approximate fourth order equations. Deflections, bending stresses, and membrane stresses are evaluated. Both simply supported and clamped ends are considered. (auth)

16088 TID-5916

Johns Hopkins Univ., Baltimore.
A BOUNDARY LAYER ANALYSIS OF THE KINETICS OF REACTION ON A FLAT PLATE. Interim Report. J. F. Wehner. May 13, 1960. 10p. Contract AT(30-1)-2334. OTS.

The solutions of the boundary layer equations involving diffusion to a surface and reaction there are determined approximately by using the diffusion analog of the von Karman momentum integral assuming that the concentration field is similar to the velocity field which may be approximated by several well known forms. The concentration field corresponding to the velocity field is written in terms of a concentration boundary layer thickness and substituted into the analog integral. The surface concentration is obtained as a function of the surface reaction rate and the boundary layer thickness. The functionality is nearly independent of the form used in the approximation. The assumed concentration field then is used in the boundary condition at the surface to obtain another relationship between surface concentration, boundary layer thickness, and surface reaction rate. By a simultaneous graphical solution of the two equations, it is possible to determine the reaction rate as a function of concentration and thus to determine the kinetics. (auth)

16089 UCRL-1026

California. Univ., Berkeley. Radiation Lab.
TRITIUM PRODUCTION. DEPENDENCE OF PURITY ON NEUTRON FLUX. C. M. Van Atta. Nov. 27, 1950. Decl. Mar. 24, 1960. 10p. OTS.

Calculations are presented showing the dependence of purity on neutron flux intensity in tritium production. (C.J.G.)

16090 UCRL-5937-T

California. Univ., Livermore. Lawrence Radiation Lab.
STATE OF MATTER AT HIGH PRESSURE. Berni J. Alder. Mar. 31, 1960. 24p. Contract W-7405-eng-48. OTS.

The region where exact thermodynamic description of the state of matter at high pressure and high temperature is possible is located. In the remaining region various approximate theories and empirical relations are discussed. These considerations are applied to hydrogen to locate the density and pressure at which the diatomic bond collapses. Also the approximate conditions are determined at which no bound electron states exist. (auth)

16091 UCRL-9053

California. Univ., Berkeley. Lawrence Radiation Lab.
RANGE-ENERGY RELATION FOR HEAVY IONS IN METALS. Edward L. Hubbard. Jan. 25, 1960. 26p. Contract W-7405-eng-48. OTS.

The range-energy relations for C, N, O, Ne, and Ar ions in Be, Al, Ni, Cu, Ag, and Au were calculated from the experimental range-energy relation for these ions in emulsion. The calculated curves are compared with experiment in the cases for which experimental data are available. (auth)

16092 UCRL-9109

California. Univ., Berkeley. Lawrence Radiation Lab.
PARAMAGNETIC RESONANCE OF TETRAVALENT Pa^{231} (thesis). Ru-Tao Kyi. Mar. 4, 1960. 66p. Contract W-7405-eng-48. OTS.

The paramagnetic-resonance spectrum of tetravalent Pa^{231} was observed in a matrix of Cs_2ZrCl_6. A melt of Cs_2ZrCl_6 was doped with ~500 μgms of anhydrous $Pa^{231}Cl_4$ and allowed to crystallize in an atmosphere of hydrogen by slow passage through a furnace. At 4°K the observed resonance pattern consisted of four widely separated hyperfine components. The spectrum was isotropic to within the accuracy of the field measurements (~½%). These features are interpreted as the "allowed" transitions between levels caused by the perturbation $\mathcal{H} = g\beta\,\vec{H}\times\vec{S} + A\,\vec{I}\times\vec{S}$ with $S = \frac{1}{2}$ and $I = \frac{5}{2}$. Best fit for the data is obtained with $|g| = 1.148$ (±0.005) and $|A| = 0.0529$ (±0.0005) cm^{-1}, no resonance was detected at 77°K. The nuclear-spin assignment of $\frac{5}{2}$ is verified. The paramagnetism can be most plausibly ascribed to a single 5f electron. A magnetically isotropic Kramer's doublet is expected to be the lowest lying as the result of the octahedral perturbation present in a Zr site. As an alternative, a 6d' configuration is expected to give rise to a four-fold degenerate magnetically anisotropic level if octahedral symmetry is preserved, or an anisotropic doublet if distortion is present. (auth)

16093 WADC-TR-59-473

Minnesota. Univ., Minneapolis.
STUDY OF ELECTRICAL AND PHYSICAL CHARACTERISTICS OF SECONDARY EMITTING SURFACES. Period [covered] October 16, 1957 to February 15, 1959. W. G. Shepherd. Sept. 25, 1959. 64p. Project No. 4152. Contract AF33(616)-3325. OTS.

This report summarizes research concerned with the secondary emission properties of materials with high secondary yield and is primarily concerned with films and single crystals of magnesium oxide. Changes are described which were adopted in the vacuum techniques and target handling and preparation procedures during the period of this contract. An extensive discussion is included on the occurrence and influence of electric fields which build up in thin MgO films during operation as secondary emitters. These fields may enhance the secondary emission by 20 to 30 per cent, or under appropriate conditions, limit the secondary emission through the "coplanar grid effect." Methods are described for the oscillographic display of secondary emission yield curves and collector characteristics, and the influence of surface charging of the emitter on

these curves is described. A study of the oxidation schedule for silver-magnesium alloy is described, and a revised schedule is presented for the preparation of MgO films with optimum secondary yield. Investigation of the stability under electron bombardment showed some temporary and some permanent damage, but no rapid initial decay was observed. A broad investigation of the influence of adsorbed cesium on the secondary emission properties of MgO films is reviewed. Because of the well-defined experimental conditions possible, the secondary emission from MgO single crystals was studied, and results are presented for the case of crystals cleaved in vacuum. Theoretical studies pertaining to the experimental work are reviewed. (auth)

16094 WAPD-TM-209

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

AN EXPERIMENT TO MEASURE EFFECTIVE DELAYED NEUTRON FRACTIONS. S. Kaplan and A. F. Henry. Feb. 1960. 32p. Contract AT-11-1-GEN-14. OTS.

An experimental measurement of the effective delayed neutron fraction ($\bar{\beta}$) was made for a clean critical assembly by determining the asymptotic period associated with introduction of a known amount of reactivity. The "known amount" of reactivity was obtained by replacing, uniformly throughout the reactor, a small quantity of U^{235} with an alloy of B^{10} and Hf designed to match the absorption properties of U^{235}. The replacement was thus equivalent to a uniform reduction in ν, the number of neutrons emitted per fission from the fuel. Such a reduction introduces a reactivity change equal exactly to $\delta\nu/\nu_0$. Two analyses of the experiment were made using different high energy cross sections in conjunction with four group, two dimensional diffusion theory. The measured value of $\bar{\beta}$ lay between the results of these computations, the error spread (an average rms error of ±5.2%) being too great to permit any conclusion regarding the significance of the comparison. (auth)

16095 AEC-tr-4074

STATE OF SOLID SUBSTANCES. E. Grüneisen. Translated by Margaret Zhart from Handbuch der Physik 10, 1-59(1926). 89p. JCL.

A survey of the relations of thermal-elastic properties in solid substances is presented. The aim of these efforts is to refer from these properties to a few characteristic values of the atoms or to individual elemental structure. A description of the theory of solid substances is also proposed. (J.R.D.)

16096 AEC-tr-4082

ON CERTAIN RELATIONSHIPS BETWEEN CLASSICAL STATISTICS AND QUANTUM MECHANICS. (Über Einige Beziehungen Zwischen Klassischer Statistik und Quantenmechanik). Reinhold Fürth. Translated for Oak Ridge National Lab. from Z. Physik 81, 143-62(1933). 51p. (Includes original, 19p.). JCL.

Relationships between classical statistics (the classical theory of diffusion and the theory of Brownian movement) and quantum mechanics are examined. It is shown that the Heisenberg uncertainty relations can be transposed to processes which are controlled by classical statistics and that a fresh view regarding the limits of the measuring possibilities of an instrument is possible. (J.R.D.)

16097 AECL-978

THE ABSOLUTE MEASUREMENT OF RADIOACTIVE SOURCE STRENGTHS BY MEANS OF A NEW FORM OF THE COINCIDENCE METHOD. K. P. Meyer, P. Schmid, and P. Huber. Translated by J. Wilkinson from Helv. Phys. Acta 32, 423-4(1959). 26p. AECL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 2563.

16098 NASA-TT-F-38

Christian-Albrechts-Universität, Kiel.

AN EXPERIMENTAL DETERMINATION OF THE ABSOLUTE OSCILLATOR STRENGTHS OF THE LINES OF TWO N II SUPERMULTIPLETS. Translation of "Eine experimentelle Bestimmung der absoluten Oszillatorenstärken der Linien zweier N II-Supermultipletts." Frithjof Mastrup. 1957. 20p. OTS.

An experimental determination of the absolute oscillator strengths of several N II-lines is described. The light source was the plasma of a wall-stabilized enclosed cylindrical arc in pure nitrogen. The parameters of this plasma near the axis of the arc were calculated from the measured total intensity of the hydrogen-like triplet-multiplet of the series 2p3d-2p4f. It was assumed that the oscillator strengths of this multiplet can be calculated by the Bates and Damgaard Coulomb field approximation. An attempt was made to check the measured oscillator strengths of the N II line in the nitrogen plasma by measurements in a helium-nitrogen mixture, using the known oscillator strengths of helium. (auth)

16099

THE ROTATION OF LIQUID HELIUM II. H. E. Hall (Univ. of Manchester, Eng.). Advances in Phys. 9, 89-146(1960) Jan.

The foundations of Landau's theory have been considerably strengthened by Feynman's deduction of the phonon-roton excitation spectrum and by inelastic scattering of cold neutrons. A development for the interpretation of the condition curl $V_s = 0$ by a rather less restrictive condition, which is interpreted as meaning that curl $V_s = 0$ almost everywhere in the liquid. There may be certain lines in the liquid on which the velocity is singular. The consequences of the circulation around these quantized vortex lines are explored. "Rotation," here, is defined as flow in which circulation of the superfluid exists. A definite theoretical viewpoint is adopted for the discussion and is used to give a unified account of as many experimental facts as possible. Various types of flow are discussed in order of increasing complexity, proceeding from irrotational circulation through macroscopically uniform rotation to turbulence. Though many of the arguments and conclusions presented may subsequently be proven wrong, Feynman's basic idea of quantized vortex lines can explain so many diverse experimental results that one can be confident that it will find a permanent place in the theoretical description of liquid helium II. (B.O.G.)

16100

ATOMIC LEVEL ENERGIES IN RARE EARTH ELEMENTS. Pär Bergvall and Stig Hagström (Univ. of Uppsala). Arkiv Fysik 17, 61-79(1960). (In English)

The L_I, L_{II}, and L_{III} level energies have been measured in the oxides of stable rare earth elements ($57 \leq Z \leq 60$, $62 \leq Z \leq 71$), employing the photo electron method. The $L_{II}-L_{III}$ energy differences are found to agree within 0.5 ev with the $K\alpha_1 - \alpha_2$ x-ray emission energy differences. A comparison with theoretical predictions is also made, and the possibility of a quantitative estimate of nuclear size effects on the fine structure is discussed. The L levels and the K level (obtained by addition of the Kα lines) are compared with data from x-ray absorption spectroscopy, showing systematic discrepancies especially for the L_I level. (auth)

16101

THE DISTRIBUTION OF IONS FORMED BY ATTACHMENT

OF ELECTRONS MOVING IN A STEADY STATE OF MOTION THROUGH A GAS. C. A. Hurst and L. G. H. Huxley (Univ. of Adelaide). Australian J. Phys. 13, 21-6 (1960) Mar.

The distribution of ions formed by attachment of electrons diffusing through a gas is solved exactly, and the results compared with an approximate calculation given earlier by Huxley. The corrections to the approximate results are inside the present experimental error, and so confirm the satisfactory agreement with experiment already obtained. (auth)

16102

ATOMIC NUMBERS OF ELEMENTS. Rose Aynard. Compt. rend. 250, 2848-9(1960) Apr. 25. (In French)

The formula previously formulated to give the atomic numbers of elements (Compt. rend. 250, 2804(1960)) is used for a tabulation of the elements up to Z = 113. (J.S.R.)

16103

NEUTRON SCATTERING AND THE CRYSTALLINE STARK EFFECT IN RARE EARTH OXIDES. Daniel Cribier and Bernard Jacrot (Centre d'Études Nucléaires, Saclay, France). Compt. rend. 250, 2871-3(1960) Apr. 25. (In French)

The decomposition of the ground level of magnetic ions of rare earths by the crystalline field was measured with the aid of inelastic scattering of neutrons. Transitions of 365 and 76 cm^{-1} were found in Ho_2O_3 and of 420.81 and 40.5 cm^{-1} in Er_2O_3. (tr-auth)

16104

CALCULATION OF REACTION PROFILES BEHIND STEADY STATE SHOCK WAVES. II. THE DISSOCIATION OF AIR. Russell E. Duff (Los Alamos Scientific Lab., N. Mex.) and Norman Davidson (California Inst. of Tech., Pasadena). J. Chem. Phys. 31, 1018-27(1959) Oct.

A numerical integration procedure was used to investigate the reaction profile behind strong shock waves in air. The Mach number range from 8 to 15 was covered; the initial temperature was 300°K; and the initial pressures were 1 and 10 mm Hg. The dissociation reactions for O_2, N_2, and NO were considered along with the "shuffle" reactions $N + O_2 \rightleftharpoons NO + O$ and $O + N_2 \rightleftharpoons NO + N$. No ionization reactions were included. Above $M_s = 10$, the calculations show a pronounced transient maximum in the NO concentration. In addition, the rates of change of concentrations at constant volume of all species except O_2 change sign under certain conditions. Several additional calculations were made which included an approximate treatment of the effects of a finite rate of vibrational excitation of O_2 and N_2. These calculations suggest that even at $M_s = 15$, the vibrational excitation reactions have only a limited effect on the reaction profile. A calculation of the reaction profile for air at high pressure diluted with a large excess of inert gas at 3000°K showed that the Zeldovich mechanism approximately describes the production of NO under these conditions even though it fails completely for undiluted air at high temperatures. (auth)

16105

ON THE PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION OF ELECTROLUMINESCENT PHOSPHORS. Paul Goldberg and S. Faria (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Electrochem. Soc. 107, 521-6(1960) June.

Through controlled removal of surface layers, it was found that surface chemical barriers are not responsible for electroluminescence in zinc sulfide phosphors. Polycrystalline phosphors are shown to be almost uniform with respect to chemical, physical, and electroluminescent properties as one passes from the surface into the crystallite bulk. Electron micrographs show the character of the particles as successive layers of phosphor surfaces are removed by acid etching. The experimental results at progressive stages of etching are interpreted in terms of an inefficient surface layer and of decreased particle size after etching. Regions capable of serving as the site of field intensification are held to exist throughout the volume of the particles. (auth)

16106

EFFECTS OF THE BOLTZMANN ELASTIC COLLISION OPERATOR ON AN ISOTROPIC VELOCITY FUNCTION IN AN IMPERFECT LORENTZ GAS. E. Moreau and J. Salmon (Commissariat à l'Énergie Atomique, Saclay, France). J. phys. radium 21, 217-22(1960) Apr. (In French)

The elastic collision operator is explained for the isotropic part of an imperfect Lorentzian gas. The formula of Chapman and Cowling is reobtained and the fields in which it is valid are specified. Other expressions are proposed for fields where this formula proves to be inapplicable. (auth)

16107

RECORDING OF EXTRAPOLATION CURVES IN THE PRODUCTION OF 4π-PREPARATIONS FOR ABSOLUTE COUNTING. M. Leistner (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie 3, 388(1960) Apr. (In German)

It is shown that the weight of an active liquid drop can be determined to 1% in 3 min with a compensograph and an electronic balance. This procedure, using a Sartorius electronic balance and a Sunvic compensation recorder, is briefly described and discussed as to its usefulness in 4π-counting. (T.R.H.)

16108

RELATIVITY AND QUANTUM THEORY. B. Kurşunoğlu (Univ. of Miami, Coral Gables, Fla.). Nuovo cimento (10) 15, 729-56(1960) Mar. 1. (In English)

It is shown that Einstein's generalized theory of gravitation as modified contains integral and half integral spin fields. A constant of the dimension of a length plays a basic role in distinguishing between Boson and Fermion type fields. (auth)

16109

EXPERIMENTAL BEHAVIOUR OF IONIC STRUCTURES IN LIQUID HELIUM. [PART] II. G. Careri, U. Fasoli, and F. S. Gaeta (Università, Padua). Nuovo cimento (10) 15, 774-83(1960) Mar. 1. (In English)

Experiments were performed to select a proper model among some proposed structures for helium ions in liquid helium. The apparatus is essentially a diode, where the ions are produced by α-rays and the currents can be measured in the bulk liquid, in the liquid-vapor interphase, and in the bulk solid. By the quite different behavior of the positive and negative ions in the interphase experiments one is led to picture the positive ion as a cluster of polarized atoms around one charge, and the negative ion as a large cage where the electron is self-trapping. (auth)

16110

VANADIUM ACTIVATED ZINC AND CADMIUM SULPHIDE AND SELENIDE PHOSPHORS. M. Avinor and G. Meijer (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Phys. and Chem. Solids 12, 211-15(1960) Feb. (In English)

Vanadium-activated ZnS, ZnSe, CdS, and CdSe powders

were prepared. All these powders show a fluorescence at about 2 μ. Addition of copper and silver as auxiliary activators enhances the vanadium emission, while the well known silver and copper emissions do not appear. (auth)

16111

ELECTRIC FIELD DISTRIBUTIONS IN AN IONIZED GAS. [PART] II. Bernard Mozer and Michel Baranger (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 118, 626-31 (1960) May 1.

A method previously described is used to calculate the probability distribution of the low-frequency component of the electric field at a neutral point, the distribution of the low-frequency component at an ion, and that of the high-frequency component at an electron. The results are compared with those obtained by other authors. (auth)

16112

NUCLEAR QUADRUPOLE AND ELECTRONIC HEAT CAPACITIES OF BISMUTH. Norman E. Phillips (Univ. of California, Berkeley). Phys. Rev. 118, 644-7(1960) May 1.

The heat capacity of bismuth was measured from 0.1 to 2.0°K and found to be represented by $C = 2.8 \times 10^{-7}\ T^{-2} + 2.1 \times 10^{-5}\ T + 1944(T/\theta)^3$ joules/mole deg with $\theta = 120.4 - 0.6T^2$. The T^{-2} term in the heat capacity is assumed to be associated with the alignment of the nuclear electric quadrupole moment in the electric field gradient of the crystal and is used to obtain the value 25 Mc/sec for the quadrupole coupling constant. The linear term is used, together with known parameters for the electrons in the conduction band, to obtain an average effective mass for the holes in the valence band of 0.9 times the free electron mass. (auth)

16113

SPIN RESONANCE OF CHARGE CARRIERS IN GRAPHITE. G. Wagoner (National Carbon Co., Cleveland). Phys. Rev. 118, 647-53(1960) May 1.

The reported observations of the electron spin resonance in quite perfect single crystals of graphite clearly establish that the resonance arises from mobile charge carriers. The line shape is of the Dysonian form which is characteristic of conduction electron spin resonance in metals. The intensity of the spin resonance agrees, both in absolute magnitude and in temperature dependence, with values calculated from the band model of graphite by McClure. The g value of the resonance shows a remarkably large anisotropy which depends strongly on temperature and on the position of the Fermi level with respect to the band edge. At room temperature in pure graphite, g varies from 2.0026 ± 0.0002 to 2.0495 ± 0.0002 as the magnetic field is shifted from perpendicular to parallel to the c axis. The g-value anisotropy increases with decreasing temperature; $g_{\parallel}$ becomes 2.127 at 77°K while $g_{\perp}$ remains constant. The line width of the resonance is a few gauss ($T_2 = 2.0 \times 10^{-6}$ sec) which is extremely narrow in comparison with the field shifts caused by changes of anisotropy with temperature. This indicates that for conduction states in graphite, the g value is a strong function of the wave vector and that the line is narrowed by an averaging process in k space. This averaging is similar to that which occurs in motional and exchange narrowing. (auth)

16114

ENERGY RENORMALIZATION IN ORDINARY WAVE MECHANICS. Marcel Wellner (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 118, 875-7(1960) May 1.

A very simple, exactly soluble compound-particle model, proposed by Wigner and Weisskopf in 1930, is briefly re-examined from the standpoint of renormalization. It consists of postulating, in the center-of-mass system, the wave equations $[i(\partial/\partial t) + (1/2m)\nabla^2]\psi(x,t) = F(x)\chi(t)$ and $[i(d/dt) - \mu]\chi(t) = \int d^3x\ F(x)\psi(x,t)$ for two particles of separation x and reduced mass m, interacting through the formation and decay of an intermediate particle with a real form factor F. The analytic behavior of the S matrix is discussed in the local case $F(x) = C\delta(x)$. (auth)

16115

VAPOR PRESSURES OF He^3–He^4 MIXTURES. S. G. Sydoriak and T. R. Roberts (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 118, 901-12(1960) May 15.

Vapor pressures, P_X, of He^3–He^4 mixtures ranging in liquid mole fraction, X, from 0.1 to 0.9 were measured between 0.6° and 2.4°K versus the vapor pressure, P_3^0, of liquid He^3. Except for sharp breaks in the vicinity of the lambda and stratification temperatures of some of the mixtures, P_X/P_3^0 is found to vary slowly and smoothly with X and with temperature. Contrary to much of the work of other authors, there are no breaks at the He^4 lambda temperature. A comprehensive smoothed table of P_X/P_3^0 is derived. Using this as a reference it is possible, for the first time, to intercompare all of the previously existing data on P_X. The data of some authors are in excellent agreement with our table but other data are in serious quantitative disagreement near 1.2°K and much previous data are in qualitative disagreement at the He^4 lambda temperature. (auth)

16116

THERMAL CONDUCTIVITY OF ISOTOPIC MIXTURES OF SOLID HELIUM. Edward J. Walker and Henry A. Fairbank (Yale Univ., New Haven). Phys. Rev. 118, 913-19(1960) May 15.

The thermal conductivity of solid He^4 containing zero, 0.56, 1.38, and 2.8 He^3 was measured as a function of temperature from 1.1 to 2.1°K. For pure He^4, the results are in satisfactory agreement with those of Webb, Wilkinson, and Wilks. The addition of 1.38% He^3, at a sample density $\rho = 0.208$ g cm^{-3} caused a decrease in thermal conductivity by a factor of 5 at 1.1°K. The additional thermal resistance caused by adding He^3 was substantially independent of temperature, rather than proportional to temperature, as would be expected from isotropically distributed point scatterers. Agreement with Klemens' theory in magnitude and temperature dependence can be obtained by assuming the He^3 to be arranged on lines in the solid. Possible mechanisms to explain these results are discussed. (auth)

16117

NEGATIVE CURRENT-VOLTAGE CHARACTERISTICS IN HYDROGEN AT HIGH PRESSURE USING PLANE PARALLEL ELECTRODES. D. J. DeBitetto and L. H. Fisher (New York Univ., New York) and A. L. Ward (Diamond Ordnance Fuse Labs., Washington, D. C.). Phys. Rev. 118, 920-3(1960) May 15.

In conjunction with measurements of current-voltage characteristics in hydrogen, a few characteristics were obtained which include a region with negative slope. The latter characteristics were obtained with plane parallel electrodes at an electrode separation of 2 cm at a pressure of 400 mm Hg and with three values of externally initiated cathode current. The initial currents ranged from about 10^{-11} to 10^{-9} amp, and the amplified currents reached values as high as 10^{-4} amp. The characteristics corresponding to the larger initial currents become negative at large currents ($\sim 10^{-5}$ amp). The voltage at which a characteristic becomes negative, i.e., the maximum attainable voltage across the electrodes, decreases

slightly with increasing initial current. The circuit included a series resistor of 20 megohms. These characteristics can be explained quantitatively on the basis of the first and second Townsend coefficients (previously measured with the same apparatus) acting in conjunction with space charge, if a not unreasonable discharge area is assumed. These calculations were carried out on an IBM 704 computer. (auth)

16118

FREQUENCY FACTOR AND ENERGY DISTRIBUTION OF SHALLOW TRAPS IN CADMIUM SULFIDE. James J. Brophy and Robert J. Robinson (Armour Research Foundation, Chicago). Phys. Rev. 118, 959-66(1960) May 15.

Current noise and photoconductivity measurements taken under uniform 5200 A illumination on CdS single crystals are used to derive the energy distribution and frequency factor of shallow traps in the range 0.3 to 0.6 electron volt below the conduction band for samples of different CuCl impurity content. Trap densities varying from 10^{12} to 10^{17} cm^{-3} ev^{-1} and total trap concentrations of 10^{16} cm^{-3} with discrete levels at 0.36, 0.43, and 0.60 ev below the conduction band are observed. In a moderately doped, good photosensitive crystal, the traps also have a continuous distribution in energy and all have the same frequency factor, 10^{11} sec^{-1}, which suggests the traps are structurally similar. The results imply that a photoelectron may experience several thousand retrapping transitions on the average before recombining. It is possible to account semiquantitatively for the $1/f$ noise spectrum observed in some crystals at high frequencies in terms of the near exponential trap distributions and constant frequency factor derived from low-frequency noise measurements. (auth)

16119

STUDY OF THE INTERMEDIATE STATE IN SUPERCONDUCTORS USING CERIUM PHOSPHATE GLASS. Warren DeSorbo (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters 4, 406-8(1960) Apr. 15.

The Faraday effect in glasses containing cerium metaphosphate is used to resolve the intermediate state in various superconducting metals. Photographs of ~0.25-mm thick glass at the surface of the metal with a transverse magnetic field are given for the following conditions and metals: (1) the magnetic field is less than H_c, the critical field (tantalum), and (2) the magnetic field is more than H_c and is then decreased to a value considerably below H_c (tin). Patterns of normal and superconducting domains appear on the photographs. Possibilities of the application of similar glasses to the study of superconductors are pointed out, e.g., in motion pictures to record kinetic details like wall motions and annealing behavior of frozen-in flux. (D.L.C.)

16120

SPUTTERING THRESHOLDS AND DISPLACEMENT ENERGIES. Robley V. Stuart and Gottfried K. Wehner (General Mills, Minneapolis). Phys. Rev. Letters 4, 409-10 (1960) Apr. 15.

A spectroscopic method for the measurement of small numbers of atoms sputtered at low energies was developed; a strong emission line of the target material is monitored by a monochromator and measured by a photomultiplier detector. The plot of spectral line intensity vs. bombarding ion energy in most cases closely matches the yield plot obtained by absolute methods. The sensitivity of this method is 10^{-4} or more atoms per ion for many metals. Measurement of yields was made for about 20 metals sputtered by Ar^+ and Hg^+ ions; one such yield curve is given for chromium. The results indicate that yields at very low ion energies (< 50 ev) become sensitive to the anode voltage above a critical value and decrease with decreasing ion energy more rapidly than previous estimates. The threshold energy for sputtering appears to be 15 to 45 ev, with 25 ev as the approximate value for Ar^+ ions; this is on the same order as the displacement threshold energy for radiation damage. (D.L.C.)

16121

AUGER EFFECT IN MESONIC ATOMS. Richard A. Ferrell (Univ. of Maryland, College Park, and European Organization for Nuclear Research, Geneva). Phys. Rev. Letters 4, 425-8(1960) Apr. 15.

An alternative to the usual perturbation method for the calculation of the Auger effect is given with the purpose of explaining the serious discrepancies in Stearns and Stearns' data for the x-ray yields in μ- and π-mesic atoms. A quantitative relationship between the Auger effect and the photoelectric cross section is derived, and the perturbation method is shown to be reliable. A plot of Stearns and Stearns' data vs energy instead of vs atomic number gives a good fit of the data to a smooth curve, indicating a yield independent of the target and dependent only on the quantum energy. If the linear efficiency represented by this curve is divided into the π-K yields, they are changed into a decreasing monotonic function of atomic number, which is to be expected if only nuclear absorption competes with radiation. The possibility of circuit inefficiencies and high cyclotron intensities causing the discrepancies in Stearns and Stearns' data is discussed. (D.L.C.)

16122

PVT ANOMALIES IN He^3 NEAR ITS MELTING CURVE. S. G. Sydoriak, R. L. Mills, and E. R. Grilly (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters 4, 495-7 (1960) May 15.

The PVT melting properties were measured for high-purity He^3 down to 0.3°K. A melting curve is given for the molar volume of liquid and solid in the bath. Thermal expansion and compressibility coefficients are shown along the melting curve. The results gave $P_{min} = 28.91 \pm 0.02$ atm and $T_{min} = 0.330 \pm 0.005$°K. (B.O.G.)

16123

DIRECTION OF THE EFFECTIVE MAGNETIC FIELD AT THE NUCLEUS IN FERROMAGNETIC IRON. S. S. Hanna, J. Heberle, G. J. Perlow, R. S. Preston, and D. H. Vincent (Argonne National Lab., Ill.). Phys. Rev. Letters 4, 513-15(1960) May 15.

It has been shown previously that the effective magnetic field at the nucleus of ferromagnetic iron is strongly correlated with the magnetization. This correlation was established by observing the change in the hyperfine splitting of the nuclear energy levels of Fe^{57}. The effective field was determined to be −333 k gauss. (B.O.G.)

16124

THE EFFECT OF A DENSITY MAXIMUM NEAR THE λ POINT ON THE TEMPERATURE DISTRIBUTION IN LIQUID HELIUM I. C. E. Chase, E. Maxwell, and W. M. Whitney (Massachusetts Inst. of Tech., Cambridge). Physica 26, 160-2(1960) Mar. (In English)

Measurements of the index of refraction and dielectric constant and the behavior of the specific heat of liquid helium indicate that the density passes through a maximum near the λ point. To investigate this, a volume of liquid helium was cooled slowly by surface evaporation; so that the heat flow is directed upward by convection. This evaporation process is continued until the surface reaches the temperature of the density maximum, where convection is no longer possible. Assuming that the temperatures on each side of the layer formed at the density

maximum are $T_{\sigma max}$ and T_λ and the thermal conductivity is independent of temperature for this range, then it is possible to calculate the thickness of the layer for any given set of experimental conditions. (B.O.G.)

16125

ON THE EXCESS THERMODYNAMIC PROPERTIES OF He^3-He^4 AND H_2-D_2 LIQUID MIXTURES. M. Simon and A. Bellemans (Univ. of Brussels). Physica 26, 191-7 (1960) Mar. (In English)

The theory of isotopic mixtures developed by Prigogine et al. is applied to liquid He^3-He^4 and H_2-D_2 mixtures. The excess thermodynamic properties are determined from the properties of pure isotopes by a graphic method. The theoretical predictions are compared with experimental data. The values obtained for excess free energy and excess volume agree very well, but the excess entropy for He^3-He^4 is not in agreement with experimental results. (tr-auth)

16126

SEARCH FOR ARTIFICIAL STELLAR SOURCES OF INFRARED RADIATION. Freeman J. Dyson (Inst. for Advanced Study, Princeton, N. J.). Science 131, 1667-8 (1960) June 3.

If extraterrestrial intelligent beings exist and have reached a high level of technical development, one by-product of their energy metabolism is likely to be the large-scale conversion of starlight into far-infrared radiation. It is proposed that a search for sources of infrared radiation should accompany the recently initiated search for interstellar radio communications. (auth)

16127

GROWTH OF ACTIVATED LITHIUM FLUORIDE CRYSTALS. L. M. Belyaev, G. F. Dobrzhanskii, V. V. Chadaeva, V. P. Panova, Z. B. Perekalina, and V. N. Varfalomeeva (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst. 4, 752-4(1960) May.

Activated LiF crystals were grown. The crystals were grown by the Kyropoulos method in an open platinum crucible on a seed fixed to a cooler, protected by a platinum sheath. The activator was introduced into the previously prepared melt. The elements Mg, Al, Mn, Fe, Cu, Ga, In, and U in the form of various compounds, were used as activators. The absorption spectra and the luminescence spectra of the crystals grown were studied. (W.L.H.)

16128

ENERGY LEVELS IN A DISTORTED COULOMB FIELD. Ya. B. Zel'dovich (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Soviet Phys.-Solid State 1, 1497-1501(1960) May.

It is shown that, given a Coulomb potential, occurring everywhere but in a small region in the neighborhood of the origin, the spectrum, as a rule, differs little from the normal Bohr spectrum of the hydrogen atoms. It is possible to have a marked distortion in the spectrum only when the perturbed potential has a resonance in the scattering of the low-energy particles. Without applying perturbation theory, it was shown that the variation in the energy of the Coulomb levels is proportional to the particle density at the origin in the unperturbed solution. (W.L.H.)

16129

DEPENDENCE OF THE INDUCED CONDUCTIVITY IN CADMIUM SULFIDE ON THE ENERGY OF EXCITING ELECTRONS. S. M. Ryvkin and B. M. Konovalenko (Physicotechnical Inst., Academy of Sciences, Leningrad). Soviet Phys.-Solid State 1, 1606-9(1960) May.

In a study of the dependence of the electron-induced conductivity in CdS monocrystals on the energy of incident electrons, it was found that with increase of the electron energy the induced conductivity reached saturation. (W.L.H.)

16130

STRONG MAGNETIC FIELDS. G. M. Strakhovskiĭ and N. V. Kravtsov. Uspekhi Fiz. Nauk 70, 693-714(1960) Apr. (In Russian)

Investigations and published data on strong magnetic fields and their applications are reviewed. Various means for creating strong magnetic fields with iron-core electromagnets, with non-ferrous constant electromagnets, and the means for producing and measuring pulsed magnetic fields are discussed. 127 references. (R.V.J.)

16131

MEASUREMENT OF FLUX, EMITTANCE, AND RELATED PROPERTIES. Henry H. Blau, Jr. (Arthur D. Little, Inc., Cambridge, Mass.). p.45-53 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Development of reliable measuring techniques for application at very high temperatures is discussed. The general principles involved in such measurements are examined, and techniques now being used to study thermal radiation properties of solid materials at temperatures up to 4000°K are described. Typical experimental results are included. (J.R.D.)

16132

THERMOELECTRIC POWER. Clinton M. Kelley (Stanford Research Inst., Menlo Park, Calif.). p.212-18 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

The status of present knowledge of thermoelectric theory is discussed, and development of thermoelectric devices is outlined. Included are discussions of the development of thermoelectric generators and converters, thermoelectric properties of materials, and thermionic power converters. (J.R.D.)

16133

DIRECT CONVERSION OF HEAT TO ELECTRIC POWER; ITS PRESENT STATUS AND FUTURE PROSPECTS. John C. R. Kelly, Jr. (Westinghouse Electric Corp., Pittsburgh). p.45-50 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

The history, physics, and engineering of thermoelectricity are discussed. The efficiencies of present generators are up to 10%, with an increase to about 35% for future generators. On the basis of capital costs, thermoelectric generators are more favorable than their conventional counterparts. Thermoelectric refrigeration devices have been built which are comparable to their conventional counterparts, with additional advantages of silence, minimum thermal inertia, and adaptability to any size or shape. (B.O.G.)

16134

DEVICE AND METHOD FOR PRODUCING A HIGH INTENSITY ARC DISCHARGE. J. S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,920,234. Jan. 5, 1960.

A device is described for producing an energetic d-c carbon arc discharge between widely spaced electrodes with arc currents in excess of 100 amperes in a magnetic field of about 3000 gauss and within an evacuated enclo-

sure at a pressure of about 10^{-5} mm Hg. No defining electrodes are used in the device, thus essentially eliminating the problems of shorting which heretofore limited the amount of current that could be produced in an arc discharge. The energetic carbon arc discharge is sustained by the potential across the electrodes and by carbon ions and electrons released from the electrodes during arc operation. A large part of the potential drop of the arc occurs along the arc and many energetic electrons reach the anode because the arc pressure is relatively low, and few collisions occur. The carbon discharge is also an efficient ion pump.

16135

METHOD AND APPARATUS FOR PRODUCING INTENSE ENERGETIC GAS DISCHARGES. Persa R. Bell and J. S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,920,235. Jan. 5, 1960.

A device for producing an energetic gas arc discharge employing the use of gas-fed hollow cathode and anode electrodes is reported. The rate of feed of the gas to the electrodes is regulated to cause complete space charge neutralization to occur within the electrodes. The arc discharge is closely fitted within at least one of the electrodes so that the gas fed to this electrode is substantially completely ionized before it is emitted into the vacuum chamber. It is this electrode design and the axial potential gradient that exists in the arc which permits the arc to be operated in low pressures and at voltages and currents that permit the arc to be energetic. The use of the large number of energetic ions that are accelerated toward the cathode as a propulsion device for a space vehicle is set forth.

16136

MAGNETIC METHOD FOR PRODUCING HIGH VELOCITY SHOCK WAVES IN GASES. V. Josephson (to U. S. Atomic Energy Commission). U. S. Patent 2,922,890. Jan. 26, 1960.

A device is described for producing high-energy plasmas comprising a tapered shock tube of dielectric material and having a closed small end, an exceedingly low-inductance coil supported about and axially aligned with the small end of the tapered tube, an elongated multiturn coil supported upon the remainder of the exterior wall of the shock tube, a potential source and switch connected in series with the low-inductance coil, a potential source and switch connected in series with the elongated coil, means for hermetically sealing the large end of the tube, means for purging the tube of gases, and means for admitting a selected gas into the shock tube.

16137

APPARATUS FOR PRODUCING HIGH VELOCITY SHOCK WAVES IN GASES. F. R. Scott and V. Josephson (to U. S. Atomic Energy Commission). U. S. Patent 2,923,852. Feb. 2, 1960.

A device for producing a high-energy ionized gas region comprises an evacuated tapered insulating vessel and a substantially hemispherical insulating cap hermetically affixed to the large end of the vessel, an annular electrode having a diameter equal to and supported in the interior wall of the vessel at the large end and having a conductive portion inside the vessel, a second electrode supported at the small end of the vessel, means connected to the vessel for introducing a selected gas therein, a source of high potential having two poles, means for connecting one pole of the high potential source to the annular electrode, and means for connecting the other pole of the potential source to the second electrode.

16138

APPARATUS FOR CLEANING GASES WITH ELECTROSTATICALLY CHARGED PARTICLES. H. F. Johnstone (to U. S. Atomic Energy Commission). U. S. Patent 2,924,294. Feb. 9, 1960.

An apparatus is described for cleaning gases with the help of electrostatically charged pellets. The pellets are blown past baffles in a conduit and into the center of a rotating body of the gas to be cleaned. The pellets are charged electrostatically by impinging on the baffles. The pellets collect the particles suspended in the gas in their passage from the center of the rotating body to its edge.

16139

HIGH ENERGY GASEOUS DISCHARGE DEVICES. V. Josephson (to U. S. Atomic Energy Commission). U. S. Patent 2,925,512. Feb. 16, 1960.

The high-energy electrical discharge device described comprises an envelope, a pair of main discharge electrodes supported in opposition in the envelope, and a metallic shell symmetrically disposed around and spaced from the discharge path between the electrodes. The metallic shell comprises a first element of spaced helical turns of metallic material and a second element of spaced helical turns of metallic material insulatedly supported in superposition outside the first element and with the turns overlapping the gap between the turns of the first element.

16140

ION ACCELERATION SYSTEM. J. S. Luce and J. A. Martin (to U. S. Atomic Energy Commission). U. S. Patent 2,926,251. Feb. 23, 1960.

Well focused, intense ion beams are obtained by providing a multi-apertured source grid in front of an ion source chamber and an accelerating multi-apertured grid closely spaced from and in alignment with the source grid. The longest dimensions of the elongated apertures in the grids are normal to the direction of the magnetic field used with the device. Large ion currents may be withdrawn from the source, since they do not pass through any small focal region between the grids.

16141

ULTRASONIC NEUTRON DOSIMETER. R. Truell, J. de Klerk, and P. W. Levy (to U. S. Atomic Energy Commission). U. S. Patent 2,926,261. Feb. 23, 1960.

A neutron dosimeter is described which utilizes ultrasonic waves in the megacycle region for determination of the extent of neutron damage in a borosilicate glass through ultrasonic wave velocity and attenuation measurements before and after damage.

16142

INTENSE ENERGETIC GAS DISCHARGE. J. S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,927,232. Mar. 1, 1960.

A method and apparatus for initiating and sustaining an energetic gas arc discharge are described. A hollow cathode and a hollow anode are provided. By regulating the rate of gas flow into the interior of the cathode, the arc discharge is caused to run from the inner surface of the cathode with the result that adequate space-charge neutralization is provided inside the cathode but not in the main arc volume. Thus, the gas fed to the cathode is substantially completely ionized before it leaves the cathode, with the result that an energetic arc discharge can be maintained at lower operating pressures.

16143

SOURCE OF PRODUCTS OF NUCLEAR FISSION.

P. Harteck and S. Dondes (to U. S. Atomic Energy Commission). U. S. Patent 2,928,780. Mar. 15, 1960.

A source of fission product recoil energy suitable for use in radiation chemistry is reported. The source consists of thermal neutron irradiated glass wool having a diameter of 1 to 5 microns and containing an isotope fissionable by thermal neutrons, such as U^{235}.

16144

ARC DISCHARGE AND METHOD OF PRODUCING THE SAME. R. V. Neidigh (to U. S. Atomic Energy Commission). U. S. Patent 2,928,966. Mar. 15, 1960.

A device for producing an energetic gas arc discharge between spaced electrodes in an evacuated chamber and within a magnetic field is described. Gas is fed into the arc in a direction normal to a refluxing stream of electrons and at a pressure higher than the pressure within the chamber to establish a pressure gradient along the arc discharge formed between the electrodes. This pressure gradient establishes rotating, time varying, radial electrical fields in the volume surrounding the discharge, causing the discharge to rotate about the arc center line.

Cosmic Radiation

16145

THE IONIZING RADIATION IN SPACE. STRUCTURAL IMPLICATIONS. Norris F. Dow (General Electric Co., Philadelphia). Aero/Space Eng. 19, No. 5, 46-7; 98(1960) May.

The types of penetrating radiation which may be encountered by space vehicles are cosmic rays, trapped particles in radiation belts about the earth, and radiation from solar flares. The requirements of active and passive shielding are discussed for the protection of man in space flight. At present active shielding does not appear to offer promise of being much lighter than the equivalent lead shielding. The use of hydrogen is considered for passive shielding, since the atoms are approximately five times as effective as lead (on a weight basis) for stopping protons. When the protons are stopped, γ rays are produced which are more penetrating than the protons. While these concepts offer hope of reducing shield weight, radiation protection appears to be the major structural design problem for manned space vehicles. (B.O.G.)

16146

PHOTOMETRIC CHARGE DETERMINATION OF RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION. B. Waldeskog and O. Mathiesen (Univ. of Lund, Sweden). Arkiv Fysik 17, 427-40(1960). (In English)

A photometric method of determining the charge of relativistic heavy primary particles in photographic emulsions is described. Corrections for different emulsion effects are applied. The accuracy of the charge determination in the interval $3 \leq Z \leq 14$ is very good. The standard error corresponds to about one fifth of the distance between consecutive charges. The method may also be used for higher charges. The charge spectrum is studied in the interval $3 \leq Z \leq 14$ in emulsions flown over Texas at 41° geomagnetic latitude. The mean flight altitude was about 29 km corresponding to 14 g/cm^2 overlying atmosphere. The charge calibration is made by δ-ray counting and by studies of fragmentation of heavy nuclei in the emulsion. An extrapolation of the number of boron particles to the top of the atmosphere shows that there exists a finite flux of these particles in the primary beam. The abundance ratio N_{Boron}/N_M falls in the interval 0.13 to 0.25, depending on the fragmentation probabilities used for the extrapolation. The results further show that the relative frequency of nitrogen nuclei is small compared with the frequency of carbon and oxygen nuclei. These nuclei occur in comparable amounts. (auth)

16147

DETERMINATION OF THE CHARGE OF RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION BY δ-RAY COUNTING AND A COMPARISON WITH PHOTOMETRIC IDENTIFICATION. Olev Mathiesen (Univ. of Lund, Sweden). Arkiv Fysik 17, 441-54(1960). (In English)

A charge determination of relativistic heavy primaries in the cosmic radiation was undertaken by determining the δ-ray density, N_δ, of tracks in nuclear emulsions. The investigation was restricted to particles with well identified charges in the interval $2 \leq Z \leq 10$, which made it possible to examine the applicability of δ-ray counting in this region. The standard error in N_δ was found to be greater than expected from pure statistical fluctuations, the coefficient of variation introduced by other sources of error than statistical ones being 7%. Possible sources of error, which may explain this increase are discussed as well as different psychological factors, which affect the reproducibility. The relation between N_δ and Z^2 is found to be linear. The results obtained from the δ-ray counting are compared with photometric measurements and with other charge spectra based on δ-ray counting. (auth)

16148

THE ABUNDANCE OF NUCLEI HEAVIER THAN OXYGEN IN THE PRIMARY COSMIC RADIATION. K. Kristiansson, O. Mathiesen, and B. Waldeskog (Univ. of Lund, Sweden). Arkiv Fysik 17, 455-83(1960). (In English)

Photometric measurements were made on 61 tracks of heavy primary particles ($Z > 8$), which were found in an emulsion stack exposed over Texas at 41° geomagnetic latitude. The measurements were corrected for different emulsion effects. The tracks were selected according to a track length criterion which states that the tracks to be accepted must be long enough to give a standard error in the determination of the charge not exceeding 0.30 units of charge. The charge calibration was made by δ-ray counting and by studies of break-up events. A small amount of fast but non-relativistic particles were found in the material. These particles were identified from measurements of mean track width and rate of change of mean track width along the track. The spectrum shows well-resolved peaks. The following observations are made in the spectrum. The ratio $N(17 \leq Z \leq 26)/N(9 \leq Z \leq 16) = 0.48 \pm 0.14$ at the top of the atmosphere. The abundance of odd nuclei is much less than the abundance of even nuclei. Neon, magnesium, and silicon are the most abundant element and occur with approximately the same frequency. There are few primary particles in the charge region $17 \leq Z \leq 23$. There are two comparatively large particle groups, namely, chromium and iron of roughly the same size in the very heavy region. No particles heaver than iron were found. The relative abundance of oxygen, silicon, and iron is discussed and compared with the mean universal abundance. (auth)

16149

IDENTIFICATION OF NON-RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION BY PHOTOMETRIC MEASUREMENTS IN NUCLEAR EMULSIONS. K. Kristiansson, O. Mathiesen, and B. Waldeskog (Univ. of Lund, Sweden). Arkiv Fysik 17, 485-93(1960). (In English)

The possibility is discussed of determining the charge of a non-relativistic heavy primary particle by photometric measurements of mean track width (MTW) and the rate of

change of mean track width along the track. The error in the charge determination is sensitive to the length of the track measured and the particle velocity. Correct identification is possible as soon as the total track length is greater than 25 mm and the momentum of the particle, p_Z, is less than a value which depends on the charge. The limit is for magnesium $p_{12} \simeq 1.2$ Bev/c per nucleon and for iron $p_{26} \simeq 1.5$ Bev/c per nucleon. In an interval 1.2 to 1.7 Bev/c per nucleon for magnesium and 1.5 to 2.0 Bev/c per nucleon for iron the rate of change of MTW is too small to be used for identifications. If a particle falling in this interval is identified solely from MTW measurements the apparent charge will be one unit too high. For $p_{12} > 1.7$ Bev/c per nucleon and $p_{26} > 2.0$ Gev/c per nucleon correct identification is possible from the MTW value only. (auth)

16150

NEUTRON RADIATION OF THE EARTH. V. V. Cherdyntsev, L. I. Shmonin, V. F. Ostapenko, O. D. Khaldeev, and L. L. Kashkarov (Kazakh State Univ., USSR). Geokhimiya No. 3, 261-7(1960). (In Russian)

The neutron flux of the earth was studied by means of field settings and logging stations. Secondary neutrons of cosmic rays predominate near the earth's surface. The ratio of fast to slow neutrons decreases with the transition from native rocks to alluvia and farther to water surfaces. According to observations in mines deep in the earth, this ratio is low. According to log measurements in native rocks of ore deposits, the neutron average flux is 4 neutron/cm^2 hour, and at the areas enriched by light elements (Li, Be, F) increases up to 52 neutron/cm^2 hour, owing to the (a,n) reaction on light elements. (auth)

16151

ABSORPTION OF COSMIC RADIATION IN IRON METEORITES. L. K. Levskii (Academy of Sciences, Leningrad). Geokhimiya No. 3, 274-7(1960). (In Russian)

On the basis of He^3 content in some individual samples of the Sikhote-Alin meteorite shower, a calculation of the average length of cosmic ray adsorption was carried out. The results of experiments on cosmic radiation absorption in compact matters, carried out in a terrestrial environment, are close to these values. The calculations were carried out at different ratios of the radii of the postatmospheric and preatmospheric bodies and at different relative positions of their centers of gravity. (auth)

16152

BALLOON STUDY OF HIGH-ALTITUDE RADIATIONS DURING THE INTERNATIONAL GEOPHYSICAL YEAR. J. R. Winckler (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 1331-59(1960) May.

The results of a series of 85 constant level balloon flights conducted during the IGY period to measure cosmic rays and other types of radiation at high altitude are summarized. Each flight carried an ionization chamber, a Geiger counter, and nuclear emulsions, and remained at approximately 10 g/cm^2 depth for times between 2 and 24 hours. The majority of flights were made at Minneapolis, Minnesota. The large decrease in primary cosmic-ray intensity between 1956 and 1958 was observed at high altitude. The high-altitude measurements correlate with sea-level neutron instruments. Many special events were detected, including x rays produced by electrons incident on the atmosphere during strong aurorae and solar cosmic rays detected on ten occasions and correlating with other known observations made in the polar regions. In one case γ rays originating on the solar surface were detected in a short burst. Several cases of radioactive layers in the atmosphere at low level resulting from nuclear explosions were found. This paper summarizes the entire program, and gives the instrumental details, a summary of published information, and detailed analysis of many data not heretofore published. (auth)

16153

OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959, PART 1. R. L. Arnoldy, R. A. Hoffman, and J. R. Winckler (Univ. of Minnesota, Minneapolis). J. Geophys. Research 65, 1361-76(1960) May.

An integrating ionization chamber and a single Geiger counter were flown on United States satellite Explorer VI in an elliptical orbit extending to 48,000 km. In addition to the Van Allen inner zone and the great outer zone, a stable and distinct intermediate zone was detected throughout August and September 1959. The outer-zone intensity showed a large decrease following the sudden commencement of a geomagnetic storm. Later in the storm the outer zone increased to much in excess of its prestorm level. During stable periods the outer zone was fairly constant and less intense than it had been observed to be with Pioneer III or Pioneer IV or the first Soviet cosmic rocket. Cosmic-ray background counting rates were reached on most passes in August and September near apogee of the satellite. The radiation 'dumped' from the outer zone during the geomagnetic storm fits very well with the intensity and latitude distribution required to account for balloon observations of auroral x rays made during the IGY period. This paper is based on preliminary analysis of Explorer VI data. (auth)

16154

PARTICLE FLUXES IN THE INNER RADIATION BELT. Stanley C. Freden and R. Stephen White (Univ. of California, Livermore). J. Geophys. Research 65, 1377-83(1960) May.

Using the albedo neutron decay source, the energy spectrum of trapped protons in the inner belt has been calculated from 10 to 700 Mev. This calculation differs from those of Singer and Hess in that a nuclear interaction term, in addition to the energy loss term, has been used in the continuity equation for the steady-state condition. The spectrum agrees well with the published data. This agreement is strong evidence for the albedo neutron decay source. It also indicates that nonadiabatic losses are small for the particles measured here. A second small stack of nuclear emulsions was flown at the lower edge of the inner radiation belt 11 days after the large solar flare of May 10, 1959. The ratio of the proton flux measured on the second flight to that on the first one is 0.8 ± 0.1, indicating that the solar flare had little or no effect on the proton content of the inner belt. A flux of 2 ± 1 tritons/cm^2 sec between 126 and 200 Mev was observed; it is attributed to collisions of trapped protons with air nuclei. No other nuclei heavier than protons were seen. (auth)

16155

COSMIC-RAY CHARACTERISTICS REGISTERED IN CHACALTAYA DURING UNUSUALLY HIGH SOLAR ACTIVITY. I. Escobar and E. Maldonado (Univ. of San Andres, La Paz, Bolivia and Centro Brasilero de Pesquisas Fisicas, Rio de Janeiro); and N. W. Nerurkar and R. Romero (Univ. of San Andres, La Paz, Bolivia). J. Geophys. Research 65, 1385-90(1960) May.

Cosmic-ray meson intensity at Chacaltaya (elevation 5220 meters above sea level and magnetic latitude 4°S) registered a 9.5% decrease during three magnetic storms of July, 1959. In addition a small increase of 1 to 2% was observed in association with the first and last storms

which commenced at Chacaltaya at about noon. These features have been discussed in relation to different magnetic field structures contained in the ionized gas ejected by the sun, and it is shown that the gas had partly turbulent and partly coherent magnetic fields in it when it arrived in the earth's vicinity. (auth)

16156

VLF PROPAGATION EFFECTS OF A D-REGION LAYER PRODUCED BY COSMIC RAYS. William F. Moler (U. S. Navy Electronics Lab., San Diego, Calif.). J. Geophys. Research 65, 1459-68(1960) May.

The single-layered D-region model based only on Lyman α photoionization of nitric oxide is inadequate to explain certain aspects of VLF radio propagation. Empirical evidence indicates the existence of a second and lower D layer which is important for VLF propagation. It is shown that normal cosmic rays produce sufficient ionization for such a layer. The electron-production and -depletion processes effective below 100 km and the latitudinal distribution of cosmic-ray primaries due to the geomagnetic field are discussed. A series of electron-density profiles obtained from photoionization and cosmic-ray ionization processes is compared with the two-layered D-region model deduced from electromagnetic measurements. The calculated phase and amplitude characteristics of VLF signals reflected from the lower cosmic-ray-induced layer during the pre-sunrise hour are in good agreement with those measured. (auth)

16157

THE FORMATION OF THE D REGION OF THE IONOSPHERE. M. Nicolet and A. C. Aikin (Pennsylvania State Univ., University Park). J. Geophys. Research 65, 1469-83(1960) May.

Radiations of solar origin penetrating below 85 km in the terrestrial atmosphere are: (1) x rays of $\lambda < 10$ A; (2) Lyman α; and (3) wavelengths greater than 1800 A. These radiations can ionize: (1) molecular nitrogen and oxygen; (2) nitric oxide; and (3) various atoms such as sodium and calcium. Molecular oxygen and nitrogen are also ionized by cosmic rays. The negative ion to electron ratio is important below 70 km and affects the electron distribution below that altitude. It is possible to explain normal conditions of ionization by cosmic rays and Lyman α. Conditions due to solar flares must be explained by x rays. Above 85 km, the behavior of the ionization is related to the formation of the E layer. (auth)

16158

THE PRODUCTION OF TRITONS AND C^{14} IN THE TERRESTRIAL ATMOSPHERE BY SOLAR PROTONS. J. A. Simpson (Univ. of Chicago). J. Geophys. Research 65, 1615-16(1960) May.

Mechanisms which have been considered to explain the discrepancy in the expected triton production rate in the atmosphere are: accretion of solar-produced tritons by the earth and additional production by the low-energy component of the cosmic radiation at times of minimum solar activity. A third source is discussed, namely, intense fluxes of energetic solar protons which could produce tritons and C^{14} in the terrestrial atmosphere at times near the maximum of the solar-activity cycle. The extension of these nonrelativistic proton fluxes to normally forbidden geomagnetic latitudes as low as 51° (Chicago) was investigated. The facts necessary to estimate the contribution of solar protons to triton production within one solar cycle are given. Terrestrial triton production must be accompanied by C^{14} production from secondary neutrons in the atmosphere. The present C^{14} production is roughly in agreement with estimates derived from neutron density and the total cosmic-ray flux. The C^{14} production may average out to a lower long-time rate than estimates from this solar cycle alone would indicate. (B.O.G.)

16159

ANNUAL VARIATION OF THE MEAN ELECTRON CONCENTRATION BETWEEN 400 AND 1200 KM HEIGHT. L. Klinker, K. H. Schmelovsky, and R. Knuth. Naturwissenschaften 47, 197-8(1960). (In German)

Observations of the Faraday fadings of the Soviet earth satellite signals were made at 20 MHz to obtain information on the total electron number of the outer ionosphere. An integral evaluation method was developed on the basis of the theory of Faraday fadings. From May 1958 to the beginning of March 1959 measurements for heights between 350 and 1400 km were obtained. The results showed that the electron concentration decreases more slowly with height in the summer than in the winter. At about 1000 km the electron concentration in summer is approximately three times larger than it is in winter. (J.S.R.)

16160

COSMIC-RAY HEAVY NUCLEI AT THE GEOMAGNETIC EQUATOR. D. D. Kerlee and O. K. Krienke, Jr. (Seattle Pacific Coll. Inst. for Research, Seattle); J. J. Lord (Univ. of Washington, Seattle); and M. E. Nelson (College of Puget Sound, Tacoma). Phys. Rev. 118, 828-30(1960) May 1.

The flux of primary cosmic-ray heavy nuclei was measured with a sandwich of C-2 and G-5 emulsions near the island of Guam, magnetic latitude 4°N. The emulsions were exposed at about 101,000 ft for 7.3 hours and the calculated fluxes at the top of the atmosphere in particles/m^2-sec-sr were found to be: Li, Be, B (L nuclei), 0.26 ± 0.05; C, N, O, F (M nuclei), 0.66 ± 0.10; $Z \geq 10$ (H nuclei), 0.37 ± 0.09. This flight took place on February 12, 1957, about a year prior to the sun spot maximum; however, there is no evidence within statistical error for any changes in the composition of the primary heavy nuclei. (auth)

16161

COSMIC RADIATION INTENSITY DECREASES OBSERVED AT THE EARTH AND IN THE NEARBY PLANETARY MEDIUM. C. Y. Fan, P. Meyer, and J. A. Simpson (Univ. of Chicago). Phys. Rev. Letters 4, 421-3(1960) Apr. 15.

Data from a cosmic-ray detector (triple coincidence) carried by the Explorer VI satellite are compared with that from neutron intensity monitors on earth in order to study the effect of earth's magnetic field on sharp cosmic-ray decreases such as those observed by Forbrush. For the results reported, the satellite data made at 35,000- to 48,800-km orbits (outside the limit of the influence of the magnetic field) and neutron intensity data made at Climax, Colorado, are plotted between August 13 and 23, 1959. In nearly all the cases changes in satellite data corresponded to changes in the Climax data. A sharp, Forbrush-type decrease in the counting rates of about 15% occurred on August 20; the ratio of the relative change in the satellite detector to that in the Climax monitor was found to be 1.9 from this sharp decrease. Since the corresponding ratio for neutron intensity data at balloon altitudes during Forbrush-type decreases is ca. 1.8, it is concluded that models for such decreases cannot invoke the presence of the earth or its magnetic field. (D.L.C.)

16162

DIURNAL VARIATION OF COSMIC RAY NEUTRON INTENSITY. Ch. V. Sastry and P. S. Gill (Gulmarg Research Observatory, India). Proc. Natl. Inst. Sci. India, Pt. A, 26, 41-8(1960) Jan. 26. (In English)

A neutron monitor in operation at Gulmarg Research Ob-

servatory since July, 1958 was used to study the dependence of the diurnal amplitude of neutron intensity on geomagnetic planetary index. It is shown that there is no apparent relation between the two and that the diurnal amplitude tends to be higher on days of low mean intensity and tends to be lower on days of high mean intensity. (auth)

16163

COSMIC AND EARTH CORPUSCULAR RADIATION STUDIES WITH ROCKETS AND SATELLITES. S. N. Vernov and A. E. Chudakov. Uspekhi Fiz. Nauk 70, 585-619(1960) Apr. (In Russian)

An analysis is made of the two separate high-intensity-radiation regions discovered by artificial satellites and cosmic rockets. Gas discharge and scintillation counters were used for recording cosmic radiations. The design of the instrumentation is presented. Data recorded by the second and third "Sputniks" show the presence of an outer radiation belt consisting of electrons with energies of 100 kev. It was also shown that the belt is strongly limited by a high latitude region. (R.V.J.)

16164

POSSIBLE INFLUENCE OF NUCLEON STRUCTURE IN HIGH-ENERGY REACTIONS. Zh. S. Takibaev (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 633-4(1960) Feb. (In Russian)

The relation between the angular distribution of shower particles and the energy spectrum can be analyzed as a possible means for determining nucleon structure. In some cases the Lorentz invariant transverse pulses are introduced instead of the energy spectrum. An analysis of the degree of anisotropy in shower angular distributions in relation to the distribution of transverse component pulses was undertaken for four showers: 2 + 16p, 2 + 14n, 3 + 39p, and 2 + 15p. The distribution of $p_\perp$ in the first three showers corresponds to particles with transverse pulses over $m_\pi c$, while the magnitude of transverse particles in the 2 + 15p shower did not exceed 1.5 $m_\pi c$. The correlated data on integral angular distribution in the above showers indicate that with anisotropic angular distribution the transverse pulse magnitudes are of $m_\pi c$ order, while with a lower degree of anisotropy the magnitudes of transverse pulses quite frequently exceed $m_\pi c$. It is postulated that production of heavier mesons takes place in the case of lower anisotropy and only π mesons are produced in the case of strong anisotropy. (R.V.J.)

16165

THE DEPENDENCE OF THREE-DIMENSIONAL DEVELOPMENT OF CASCADE SHOWERS ON THE ENERGY OF PRIMARY PARTICLES. V. V. Guzhavin and I. P. Ivanenko (Inst. of Nuclear Physics, Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 38, 662-4(1960) Feb. (In Russian)

In three-dimensional theory the angular and spatial particle distribution is ordinarily calculated with the assumption that the primary particle energy is infinite. However, the electron and photon energy near the shower axis is comparable to the primary particle E_0; therefore, it cannot be considered infinite. An approximate method is suggested for calculating the above functions and for evaluating the E_0 = infinity effects on the appearance of the distribution function. The functions of electron and photon spatial distribution with energy above E with s = 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, and 1.6 and for the ratio E_0/E = 10^6, 10^4, 10^3, 10^2, and 10 were calculated. Spatial distribution functions were also calculated for electrons with E > 0 at s = 0.6, 0.8, 1.0, 1.2, 1.4, and 1.6 for the ratio E_0/β = 10^6, 10^4, 10^3, 10^2, and 10. (R.V.J.)

Criticality Studies

16166 GAT-DM-769

Goodyear Atomic Corp., Portsmouth, Ohio.

SAFE GEOMETRIES AND MASS AT ASSAYS BELOW FIVE PER CENT U^{235}. J. L. Feuerbacher. May 18, 1959. 9p. OTS.

Investigations were made to determine the most reliable method of estimating safe geometries at assays below 5% U^{235}. Conservative methods of estimating safe mass at the assays considered are also examined. Data on safe geometrical and mass parameters are included. (J.R.D.)

16167 HW-24514(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CRITICAL MASS STUDIES OF PLUTONIUM SOLUTIONS. F. E. Kruesi, J. O. Erkman, and D. D. Lanning. May 19, 1952. Reissued in declassified form, Feb. 15, 1960. 82p. Contract W-31-109-Eng-52. OTS.

The chain reacting conditions for plutonium nitrate in water solution were examined experimentally for a variety of sizes of spheres and cylinders. The effects on the critical mass of the displacement of hydrogen and the addition of poisons to the fuel were measured in water tamped and bare reactors. The data reveal that the absorption cross-section of Pu^{240} is 925 ± 200 barns and the minimum critical mass of Pu^{239} in water is 510 g at a concentration of about 33 g/liter. (auth)

16168 LAMS-2415

Los Alamos Scientific Lab., N. Mex.

CRITICAL DATA FOR NUCLEAR SAFETY GUIDANCE. H. C. Paxton, comp. Feb. 1960. 68p. Contract W-7405-eng-36. OTS.

A collection of criticality data is presented for the evaluation of nuclear safety problems. Various geometries are treated, e.g., spheres, cylinders, slabs, cubic arrays, annuli, etc. The isotopes of U^{233}, U^{235}, and Pu^{239} at various enrichments and in different solutions are considered. (W.D.M.)

16169 Y-839

Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, Tenn.

EMPIRICAL STUDIES OF CRITICAL MASS DATA. PART III. C. L. Schuske and J. W. Morfitt. Jan. 16, 1952. Decl. Mar. 7, 1960. 13p. Contract W-7405-eng-26. OTS.

The critical mass curves of an equilateral cylindrical reactor as a function of moderation were calculated by graphical methods for H: U^{235} atomic ratios of 25 down to 1.4. The critical assemblies were built up of small cubes. These cubes were of two types, H-cubes and U-cubes. The H-cubes were small blocks of polyethylene ($CH_{1.92}$) approximately 1" on the edge. The U plastic cubes (U-cubes) contained a mixture of UF_4 (U^{235}) isotopic concentration of 9.3% and polytetrafluoroethylene ($CF_{2.02}$) pressed together to form a material having an over-all density of 4.73 g/cm^3. The infinite cylinder and slab dimensions as functions of moderation were approximated for the low values of H: U^{235} atomic ratio. (C.J.G.)

Elementary Particles and Radiations

16170 AERE-R-3242

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SOME THEORETICAL ESTIMATES OF THE YIELD OF

SECONDARY PARTICLES PRODUCED BY 7 GeV PROTONS. D. Morgan. Feb. 1960. 49p. BIS.

Theoretical estimates are made of the yields of pions, K particles, and $\bar{p}$ produced by 7 BeV protons. The calculations are made according to the statistical theory of Fermi, and the resulting integrals in phase space are computed by a Monte Carlo method. For pion production, final state interactions are approximated by the isobar model. Predictions are made of the resulting laboratory distributions in momentum and angle, and some comparisons are made with experiments at similar energies. (auth)

16171 CEA-1260

France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Grenoble.

LA DIFFUSION MAGNÉTIQUE DES NEUTRONS. (The Magnetic Diffusion of Neutrons). W. C. Koehler. 1959. 86p.

A brief examination is made of the scattering of neutrons by substances, particularly by crystals containing permanent atomic or ionic magnetic moments. Ferromagnetic, antiferromagnetic, ferrimagnetic, or paramagnetic crystals are considered, but first it is necessary to touch on nuclear diffusion of neutrons. The discussion starts with interaction of the neutron with a single diffusion center; the results are then applied to the magnetic interactions of the neutron with the satellite electrons of the atom; finally the diffusion of neutrons by crystals is discussed. (auth)

16172 INS-14

Tokyo Univ. Inst. for Nuclear Study and Tokyo Univ. Coll. of General Education.

THE THEORY OF THE NUCLEON LEVEL STRUCTURE IN TERMS OF THE PION-PION RESONANCE. Kiyomi Itabashi, Masaaki Kato, Kimiko Nakagawa, and Gyo Takeda. Mar. 20, 1960. 42p.

Existence of a sharp pion-pion resonance is assumed for T = j = 1 state at about 600 Mev. This resonance state is approximately replaced by a real T = j = 1 particle $\rho^{\pm,0}$, and its interactions with the pion field and the electromagnetic field are determined. Calculation of pion-nucleon scatterings through $\rho\eta$ intermediate states shows in Born approximation that very strong attractive forces would exist for both T = ½, $d_{3/2}$ and T = ½, $f_{5/2}$ pion-nucleon states at about 600 Mev. The former is identified as the second and the latter as the third resonance observed in the pion-nucleon scatterings. Similar calculation for photopion productions shows that the second resonance should also appear but not the third one. A tentative model for explaining the fourth maximum observed in the pion-nucleon scattering is proposed along the similar line. (auth)

16173 NP-8660

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

A NOTE ON THE PHENOMENOLOGICAL THEORY OF UNSTABLE PARTICLES. Report No. 125/VII. A. Krzywicki and J. Szymański. Dec. 1959. 4p.

M. Ida's concepts of positive and negative resonances are applied to the phenomenological method of defining unstable particles through the properties of the scattering process of the stable particles. When τ_R, the mean retardation or acceleration of the interacting wave packet relative to the noninteracting one, is very large, an intermediate compound state (unstable particle) plays an important role in the scattering process. τ_R reaches a maximum in the case of positive resonance, but for negative resonance and maximum in the scattering cross section, is less than zero. Since τ_R is an essential quantity in the phenomenological theory, it is concluded that this theory has serious defects even for two-body decaying particles. (D.L.C.)

16174 NP-8709

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

EQUATIONS FOR THE LOW-ENERGY MESON-NUCLEON SCATTERING. A. V. Efremov, V. A. Meshcheryakov, and D. V. Shirkov. 1960. 18p. (D-503).

The integral equations for partial-wave amplitudes for low-energy π-N scattering are derived from the Mandelstam representation. The kernels of these equations depend on the lowest phase shifts of π-π scattering. (auth)

16175 TID-5848

Washington. Univ., Seattle.

AN EXPERIMENTAL STUDY OF CLOSE COLLISIONS OF HIGH ENERGY MU-MESONS WITH ELECTRONS. Robert Francis Deery. Apr. 1960. 99p. Sponsored by ONR and AEC under Contract Nonr-477(12). OTS.

Cosmic particles were passed through 14-in. Pb above and 10-in. Pb below the chamber and target. Knock-on electron events originating in a target above the top section of a three-section 36-in. cloud chamber operating in a field of 11,000 gauss were detected with the aid of two proportional counters which sandwich the top section. Electrons and muons were identified by their behavior in traversing Pb plates above and below the middle section. The target was 23.1 g/cm^2 of carbon in one experiment and 17.0 g/cm^2 of paraffin in the other. Energies of the electrons and muons were determined from track curvature measurements, and events accepted only when the electron energy was greater than 100 Mev and the muon energy was from 5 to 50 Bev. The distribution of electron energies was compared with theoretical predictions based on quantum electrodynamics modified by a one parameter form factor and corrected for energy loss of the electrons before reaching the chamber. The data taken at face value would suggest an excess of events with large momentum transfers (50 to 100 Mev). Because of the experimental uncertainty, the muon structure could not be determined. (auth)

16176 UCRL-8746

California. Univ., Berkeley. Lawrence Radiation Lab.

INTERACTIONS OF ANTIPROTONS IN HYDROGEN, BERYLLIUM, AND CARBON (thesis). Bruce Cork. Mar. 1960. 48p. Contract W-7405-eng-48. OTS.

Inelastic, elastic, and charge-exchange cross sections for antiprotons scattered from hydrogen, beryllium, and carbon at 133 to 333 Mev are given. The experimental results of antiproton-proton scattering were in good agreement with the calculations of Ball and Chew and Ball and Fulco. The observed scattering of antiprotons from Be and C is well described at small angles by use of the optical model. A system of 4π solid-angle scintillation counters was employed to simultaneously measure all cross sections and angular distributions. (C.J.G.)

16177 UCRL-8865

California. Univ., Berkeley. Lawrence Radiation Lab.

ANTIPROTON-PROTON CROSS SECTIONS AT 1.0, 1.25, AND 2.0 BEV (thesis). Charles A. Coombes. Mar. 15, 1960. 51p. Contract W-7405-eng-48. OTS.

The antiproton–proton interaction was studied at three energies, 2.0, 1.25, and 0.98 Bev. Antiprotons produced internally in the Bevatron and channeled externally by a system of bending magnets and quadrupoles were selected from background particles by using a gas Cherenkov counter and scintillation counters. At the two lower

energies, an electrostatic-magnetic velocity spectrometer was used to reject background particles. A liquid-hydrogen target was completely surrounded by scintillation counters so that all charged secondaries from the antiproton–proton interactions could be detected. With the information obtained from these counters, the $\bar{p}$–p total, elastic, inelastic, and charge-exchange cross sections and the angular distribution of the elastic scatterings were obtained at each energy. The total cross section was found to be 80, 89, and 100 mb at 2.0, 1.25, and 0.98 Bev, respectively. The inelastic cross section was about two-thirds of the total cross section at each energy. It was found that each of the partial cross sections was dropping off slowly with energy. The results were fitted by an optical-model calculation. (auth)

16178 JPRS-2616

NOTE ON THE ACCELERATION OF RELATIVISTIC ELECTRONS IN THE IONOSPHERE AND THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON THEIR TRAJECTORIES. A. A. Vorob'ev (Vorob'yev). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz. No. 2, 171-2(1959). 4p. OTS.

An outline of a proposal for an around-the-world echo propagation of electrons along the lower boundary of the F-layer is presented. If problems attendant to such a project can be solved, electrons can be accelerated to 10^{12} ev and greater. (J.R.D.)

16179

DIFFRACTION THEORY FOR VERY-HIGH-ENERGY SCATTERING. K. R. Greider and A. E. Glassgold (Univ. of California, Berkeley). Ann. Phys. (N.Y.) 10, 100-26 (1960) May.

In the simple diffraction theory, or black-sphere model, of Bethe and Placzek, it is assumed that partial waves with $l \leqq L$ are completely absorbed and partial waves with $l > L$ do not interact at all. (The projectile and target are assumed to have no spin or charge, so that l represents orbital angular momentum; L is a critical value of l usually related to the radius of the black sphere.) We improve this primitive but useful model by taking into account (a) the gradual, rather than sharp, transition from maximum to zero absorption, (b) the generally small but important deviation from complete absorption, and (c) finite values for the real part of the scattering amplitude. By adoption of appropriate forms for these improvements, closed-form expressions for the various cross sections are obtained. Whenever necessary, systematic approximation methods are developed which allow estimates of errors to be made. The results are shown to be model-independent, i.e., independent of the detailed way in which the above generalizations are made. Further simple improvements for the Coulomb field and spin-½ projectiles are discussed. These methods are applied to the scattering of neutrons from nuclei for neutron energies in the range from 0.3 to 5.0 Bev. (auth)

16180

ACCURACY OF γ-RAY BUILDUP CALCULATIONS FOR THIN LAYERS OF AN ABSORBING AND SCATTERING MEDIUM. A. V. Bibergal' and N. I. Leshchinskii. Atomnaya Energ. 8, 372-3(1960) Apr. (In Russian)

The attenuation of γ radiation in thin layers of absorbing and scattering media was calculated using the formula $B_0(h2, \mu_0 x, z) = A_1 e^{-\alpha_1 \mu_0 x} + A_2 e^{-\alpha_2 \mu_0 x}$ (where α_1, α_2, A_1, and A_2 are coefficients of various emissions and atomic numbers of absorbing and scattering media, μ is linear attenuation of a narrow beam, x is thickness). Data on attenuation of Co^{60} and Cs^{137} gammas in water, aluminum, steel, and lead are plotted. For materials with high atomic number the results coincide, while for water they coincide only with $x > 60$ cm. (R.V.J.)

16181

SPECTRAL DISTRIBUTIONS OF SCATTERED X RAYS AT POINTS LYING OFF THE BEAM AXIS. S. Mak and D. V. Cormack (Univ. of Saskatchewan, Saskatoon, Can. and Saskatoon Cancer Clinic, Can.). Brit. J. Radiol. 33, 362-7(1960) June.

The modification of a scintillation spectrometer so that it may be rotated about two mutually perpendicular axes is described. This arrangement greatly simplifies measurements and subsequent integration of scattered spectra at points which do not lie on axes of radial symmetry. This apparatus was used to measure scattered spectra at points at the center and near the edge of beams of 140 and 280 kvp radiation. For each point spectral distributions were measured for 30 different directions. These were then integrated to obtain the spectrum incident from all angles. These spectra were compared with those calculated using a Monte Carlo method. (auth)

16182

POLYNOMIAL APPROXIMATION IN NEUTRON TRANSPORT THEORY. J. Mika and R. Żelazny (Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 59-62 (1960). (In English)

The problem of using general orthogonal polynomials for the solution of a one-velocity Boltzmann equation in the neutron transport theory is formulated. General considerations concerning the use of Jacobi and Gegenbauer polynomials for this purpose are presented and the determination of an arbitrary parameter in Gegenbauer's case is given. (auth)

16183

SCATTERING OF KAONS WITH $\bar{K}K\pi\pi$ COUPLING IN THE FIXED-SOURCE THEORY. W. Królikowski (Warsaw Univ. and Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci., Sér. sci., math. astron. et phys. 8, 63-6(1960). (In English)

The fixed-source approach to kaon scattering has been reported. A possibility was shown to exist for a $T = 1$ resonance at high energies for scattering of kaons on nucleons. A possible kaon interaction would enable the use of a considerably smaller value for the $\bar{N}YK$ coupling constant to avoid the $T = 1$ resonance and to get the correct cross section value. It has been pointed out by Barshay that a $\bar{K}K\pi\pi$ interaction possesses the properties to meet these requirements. Thus, a new argument is gained for the existence of the $\bar{K}K\pi\pi$ interaction. (B.O.G.)

16184

ON WAVE FUNCTIONS FOR THE PROBLEM OF ELECTRON AND X-RAY SCATTERING BY HELIUM ATOMS. W. Kołos (Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 67-70(1960). (In English)

The differential cross sections of the helium atom for scattering electrons were calculated to study the dependence of the cross-section on the wave function forms and the correlation of the atomic electrons. Results from the application of these wave functions to x-ray scattering by helium atoms are given. It seems that the electron correlation has no significant influence on electron or x-ray scattering, although the result might be different for low energies in which Born's approximation breaks down. In the case where the helium energy has an intermediate value, the scattered intensities are very different from

those obtained from the other cases investigated, especially for electron scattering. This shows clearly that the energy criterion is not a useful guide when choosing an approximate wave function for the calculation of other physical quantities. (B.O.G.)

16185

ON THE POSSIBILITY OF NEUTRAL CURRENTS IN FOUR-FERMION INTERACTIONS. W. Majewski (Inst. of Physics, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 95-8 (1960). (In English)

Two "anomalous" events in the decay $K^+ \rightarrow \pi^+ +$ neutrals which energetically do not fit the schemes $K^+_{\pi 3} \rightarrow \pi^+ + \pi^0$ ($E^{kin}_{\pi^+} \approx 107.7$ Mev) or $K^+_{\pi 3} \rightarrow \pi^+ + 2\pi^0$ ($E^{kin}_{\pi^+ max} \approx 53$ Mev) were found among 1400 ordinary $K^+_{\pi 2}$ decays. An interpretation of these decays was adopted as $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ ($E^{kin}_{\pi^+ max} \approx 108$ Mev), based on the wide peak at 60 Mev for π^+-mesons from such decay. Hiida has presented results which diminishes the probability of this interpretation. Considerations are given for a different possibility for this decay, namely: $K^+ \rightarrow \pi^+ + \bar{\nu} + \nu$, ($E^{kin}_{\pi^+ max} \approx 127$ Mev), which is allowed in the four-fermion interaction scheme with neutral currents. The assumptions are given for determining hypothetical interactions with $(\bar{\nu}\nu)$ current in K-meson decay. (B.O.G.)

16186

POTENTIAL SCATTERING OF NEUTRONS FOR Fe, Co, Ni, Cu, Zn, Se. W. Ratyński, J. Turkiewicz, and P. Żuprański (Warsaw Univ.). Bull. acad. polon. sci., Sér. sci., math., astron. et phys. 8, 117-18(1960). (In English)

A method has been developed to estimate the potential scattering cross sections based on the work of Seth. Measurements have been previously obtained of σp for Al, Ag, and Bi. These measurements were extended to the elements of medium atomic weight. The calculated cross-sections and corresponding effective nuclear radii for the investigated elements are tabulated. These results are not in good agreement with the optical model for spherical nuclei. Particularly large discrepancies exist in the regions of atomic weights $30 < A < 90$ and $130 < A < 190$. Strong deformation of nuclear surfaces must be taken into account for heavy nuclei. Recent evidence indicates the existence of nuclear deformations in the $30 < A < 90$ atomic mass region. Measurements of effective nuclear radii seem to indicate the existence of such deformations. (B.O.G.)

16187

THE CLOCK PARADOX IN THE MOTION OF CHARGED PARTICLES IN A MAGNETIC FIELD. A. A. Sokolov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 131, 75-7(1960) Mar. 1. (In Russian)

An analysis is made of the clock paradox for the case of relativistic charged particle motion in a betatron. The derived formulas for time variations describing certain general problems related to the clock paradox may be experimentally verified by the investigation of the lifetimes of spontaneous charged particle decay (μ and π mesons). The probability of decay in relativistic motion at variable rates is of special interest. (R.V.J.)

16188

CHARGED HEAVY MESONS. Louis Leprince-Ringuet (College de France, Paris and l'Ecole Polytechnique, Paris). Énergie nucléaire 2, 75-80(1960) Mar.-Apr. (In French)

The general properties of heavy mesons and hyperons are reviewed, and the results obtained with cosmic-ray studies at the Pic du Midi are reported. The investigations made with accelerators in the study of mesons are then described. The basic problems posed by heavy mesons and hyperons are reviewed with emphasis on the isotopic spin, strangeness, and parity. (tr-auth)

16189

RADIATION FIELD FROM A RECTANGULAR SOURCE. J. H. Hubbell, R. L. Bach, and J. C. Lamkin. J. Research Natl. Bur. Standards 64C, 121-38(1960) Apr.-June.

Many radiation shielding problems involve calculations of the response of an isotropic detector to radiation of arbitrary angular distribution from uniform rectangular sources. In calculations of this type the family of integrals $\int_s (\cos\theta dS/r^2) P_1(\cos\theta)$ and the integral $\int_s (dS/r^2)\exp(-\mu t/\cos\theta)$ are frequently encountered, where θ is obliquity with respect to an axis perpendicular to the plane containing the rectangular radiant surface, S, r is the distance from an element source area, dS, to the detector, μ is the attenuation coefficient, and t is the barrier thickness. Solutions of the first type of integral facilitate use of Legendre expansion representations of radiation directional distributions. and may also have application in other radiant surface studies, such as illumination and heat exchange engineering. The second integral relates to exponentially attenuated radiation from a plane isotropic rectangular source separated from the detector by a layer of material of thickness t. Formulas, expansions, and numerical results are presented. (auth)

16190

MASS OF ELEMENTARY PARTICLES. S. C. Horning. Nature 186, 708(1960) May 28.

Equations are presented for use in calculating the mass of protons, mesons, hyperons, and electrons. (C.H.)

16191

MESON CAPTURE IN He^3. Carl Werntz (Institut für Theoretische Physik, Heidelberg, Ger.). Nuclear Phys. 16, 59-71(1960) Apr. (In English)

The effective Hamiltonian of Fujü and Primakoff is used to calculate the capture rate $\omega^{(\mu)}$ of μ^- mesons by He^3 leading to the bound state of H^3. The ground state of the three-body nucleus is taken to be a state with total angular momentum $\frac{1}{2}$ and isobaric spin $\frac{1}{2}$ with a small D-state admixture to the predominant S-state. The dependence of the capture rate on the percentage of D-state admixture and on the r.m.s. radius of the nucleus is found. A calculation of the r.m.s. radius using S-state wave functions derived from hard core potentials leads to values of $\omega^{(\mu)}$ 7% to 10% higher than that calculated by Fujü and Primakoff. (auth)

16192

AN INVESTIGATION OF EFFECTIVE NEUTRON TEMPERATURES. W. P. Stinson, L. C. Schmid, and R. E. Heineman (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 7, 435-41(1960) May.

Information about effective neutron temperatures has been inferred from measurements of the ratio of the thermal-fission activity of a Pu^{239} foil to that of a U^{235} foil. A discussion of the ratios obtained in various assemblies which were placed in the center of a graphite thermal column is presented. The assemblies were made of natural uranium, lead, or graphite. In some cases the assemblies were surrounded by a layer of water. The experiments were conducted at thermal-column temperatures which ranged from 18 to 640°C. The data obtained in the case of the graphite assembly are used as a calibration of the neutron temperature. To within the accuracy of the experiment, the shape of this calibration curve is the same as the shape obtained from the data of C. H. Westcott. The results, for all other cases, indicate for the range of temper-

atures investigated that the ratio of the thermal-column temperature to the effective neutron temperature in an assembly varies linearly with the temperature of the thermal column. (auth)

16193

REGARDING THE REACTION $\bar{K} + p \rightarrow \Lambda^0 + 2\pi$. J. E. Russell (Indiana Univ., Bloomington). Nuovo cimento (10) 15, 697-708(1960) Mar. 1. (In English)

A recent proposal to determine $P_{K\Lambda}$, the relative KΛ parity, by a study of the reaction $\bar{K} + p \rightarrow \Lambda^0 + 2\pi$, in flight and at low energies, is generalized to include the admittedly remote possibility of a spin 2 K-meson. The appropriate forms of the differential cross-sections are found, the treatment being non-relativistic and strictly phenomenological. The approximation for the matrix elements is based on barrier penetration considerations. Final state interactions are neglected. If the assumptions, which are the same as those made previously, are valid, $P_{K\Lambda}$ may be determined independently of whether the K-meson spin is zero or 2. There is a possibility of distinguishing spin zero from spin 2. (auth)

16194

PION-MOMENTUM SPECTRUM FROM K^- ABSORPTION IN HELIUM. J. Leitner (Univ. of California, Berkeley) and S. Lichtman (Syracuse Univ., N. Y.). Nuovo cimento (10) 15, 719-28(1960) Mar. 1. (In English)

The pion-momentum spectrum from K^--absorption stars in helium is calculated in the impulse approximation. The kaon is assumed to be pseudoscalar and to be captured from the 1s state. A final state consisting of free particles is used. The effect of final bound states is considered and taken into account phenomenologically. All final-state interactions are neglected. It is shown that the shape of the momentum spectrum is determined mainly by kinematics, i.e., the shapes and position of the spectral peaks are quite insensitive to detailed dynamical assumptions such as the nature of the K parity and capture orbit. The effect of final-state interactions is discussed. (auth)

16195

SOME PREDICTIONS FROM A COMPOSITE MODEL OF BARYONS. D. H. Frisch (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10) 15, 757-9(1960) Mar. 1. (In English)

Baryons are considered as composites of a neutral baryon core plus various mesons. This model makes three specific predictions: (1) The K^+-$\Sigma^0(\Lambda^0)$ force should be much more attractive than the K^--$\Sigma^0(\Lambda^0)$ force. (2) Neutral particles should be approximately electrically neutral throughout. (3) At high energies many elementary particle reactions should have characteristic angular distributions. (auth)

16196

RADIATIVE CORRECTIONS TO ELECTRON-ELECTRON SCATTERING. G. Furlan and G. Peressutti (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10) 15, 817-30(1960) Mar. 1. (In English)

The e^6 corrections were computed for the differential cross-section for Møller scattering. The divergences for high values of the momentum of the virtual photons were removed by the usual techniques of renormalization. The infrared divergence was eliminated by adding the cross section for the bremsstrahlung process associated with Møller scattering. Numerical computations give reasonable results for the corrections. (auth)

16197

FURTHER EXPERIMENTAL EVIDENCE CONCERNING THE FERMI-TELLER "Z-LAW." J. F. Lathrop, R. A. Lundy, R. A. Swanson, V. L. Telegdi, and D. D. Yovanovitch (Univ. of Chicago). Nuovo cimento (10) 15, 831-4 (1960) Mar. 1. (In English)

The time distribution of electrons from μ^- decaying in AgZn and Li^6I was investigated to gather evidence concerning the Fermi-Teller "Z-law." The Fermi-Teller prediction is supported by experimental evidence for the binary compound AgZn. A final corrected value for the atomic capture ratio I/Li = 15.8 ± 2.0 was found which compared with the F-T prediction I/Li = 17.6. This high ratio could be a consequence of transfer processes such as have been suggested to explain the anomalous x-ray yields observed by the Stearnses. (B.O.G.)

16198

TEST OF PARITY CONSERVATION IN STRONG INTERACTIONS BY THE MEASUREMENT OF THE β-γ ANGULAR CORRELATION OF ^{133}Xe. H. Müller and H. Schopper (Institut für Kernphysik, Mainz). Nuovo cimento (10) 15, 840-2(1960) Mar. 1. (In English)

A method is described to test the conservation of parity in strong interactions. This is achieved by observing the circular polarization of a γ ray emitted from a mixed nuclear state, for a γ-γ-cascade in which any of the two-transitions has a high ratio of matrix elements. A further transition can be achieved if the first transition is a β decay. The β-γ-angular correlation for Xe^{133} was measured to test parity conservation. The circular polarization equation is given by P = 2RF, where R is the ratio of the matrix elements, and F is the wave function amplitude for the nuclear states of the matrix elements. For parity to be conserved F = 0. Two values for R were obtained, 290 and 12. From these values the limits for F were deduced -5×10^{-6} and 1.3×10^{-4}, respectively. (B.O.G.)

16199

ELASTIC SCATTERING OF NUCLEONS AND PIONS AT VERY HIGH ENERGY. Z. Koba and A. Krzywicki (Inst. for Nuclear Research, Warsaw); R. Raczka (Warsaw Univ.); and Z. Chyliński (Inst. for Nuclear Research, Krakow). Nuovo cimento (10) 15, 843-6(1960) Mar. 1. (In English)

Assumptions usually made in the investigation of high energy elastic scattering of nucleons and pions are: (a) the real parts of all phase shifts vanish; and (b) either the scattering is spin-independent or the scattering amplitude is highly degenerate. An analysis of high energy scattering was made and discrepancies of theory were examined. The results of the investigation are discussed. (B.O.G.)

16200

POLARIZATION EFFECTS IN THE ELASTIC SCATTERING OF PHOTONS. E. Fuschini, D. S. R. Murty, and P. Veronesi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10) 15, 847-9(1960) Mar. 1. (In English)

A Co^{60} source of about one curie, emitting photons at 1.25 Mev, was used to produce a collimated beam. The beam, incident on a Hg target, was used in the study of the polarization effects in photon scattering. The polarization state was determined by means of a ratio, R', which takes into account the polarization degree and the interference between Rayleigh and Thomson effects. The result obtained, after applying correction for asymmetry of geometry, is R' = 2.3 ± 0.1, which is in good agreement with the theory of Brown and Mayers. (B.O.G.)

16201

EXPERIMENTAL EVIDENCE FOR THE PION-PION IN-

TERACTION AT 1 Gev. I. Derado (European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 15, 853-5(1960) Mar. 1. (In English)

The spectrum for π^- mesons of 1 Bev was worked out on the basis of assumed production processes and a statistical model. A histogram is given which represents the experimental measurements including statistical errors. These measurements agree better with previous results than with the predictions of the statistical model. The experimental results suggest that the $\pi-\pi$ interaction becomes increasingly important above 1 Bev. (B.O.G.)

16202

SOME CHARACTERISTICS OF INELASTIC PROTON-NUCLEON COLLISIONS PRODUCED BY PROTONS OF ENERGY 6.2 GeV IN NUCLEAR EMULSIONS. R. R. Daniel, N. Kameswara Rao, P. K. Malhotra, and Y. Tsuzuki (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 16, 1-25(1960) Apr. 1. (In English)

Nuclear interactions produced by protons of energy 6.2 Bev in nuclear emulsions were analyzed to deduce information regarding some of the characteristics of proton-nucleon collisions. 703 disintegrations were obtained by "along the track" scanning. Accurate measurements of multiple scattering and of grain density were made on favorable tracks of relativistic secondary particles; using these measurements it was possible to identify the particles up to the highest energies involved. It was found that in collisions of protons of energy 6.2 Bev with nucleons: a) the mean charged pion multiplicity is 1.51 ± 0.18; b) the mean inelasticity is 0.43, and is independent of the total multiplicity n_s; c) the nucleons recoiling in the C.M. system are strongly collimated symmetrically in the forward and backward directions; d) the mesons created in the collision also show an appreciable amount of forward-backward collimation in the C.M. system. (auth)

16203

ON THE THEORY OF SOME ČERENKOVIAN EFFECTS. G. Toraldo di Francia (Università, Florence). Nuovo cimento (10) 16, 61-77(1960) Apr. 1. (In English)

The field generated by a charged article in uniform straight motion is expanded into a set of evanescent waves. The expansion is valid in any half-space with no points in common with the path of the particle. The evanescent waves may impinge on the surface of an optical diffraction grating and be diffracted. Some of the diffracted waves turn out to be ordinary plane waves, which carry energy away from the grating. It is possible in this way to explain the Smith and Purcell effect and to derive some quantitative conclusions. (auth)

16204

PHOTOPRODUCTION OF PIONS ON PIONS. M. Gourdin and A. Martin (European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 16, 78-95(1960) Apr. 1. (In English)

Photoproduction of pions on pions is computed by means of the Cini-Fubini version of the Mandelstam technique. The problem is reduced to the resolution of a Fredholm integral equation containing an arbitrary multiplicative constant which could be determined by extrapolation of experimental cross-sections. Under the assumption of a sharp pion-pion resonance approximate solutions are derived which exhibit the same resonant behavior. (auth)

16205

A FREE NUCLEON THEORY. R. L. Ingraham (I.T.A., C.T.A., São José dos Campos, Brazil). Nuovo cimento (10) 16, 104-127(1960) Apr. 1. (In English)

A theory of the free nucleon quantum field based on the spin $\frac{1}{2}$ wave equation proposed by Murai is given. Notable features are: 1) the nucleon field is an (8-dimensional) irreducible representation of its fundamental group, the 15-parameter group of all angle-preserving transformations of space-time; 2) in spite of non-vanishing mass this nucleon possesses a new quantum number β_f, the invariant handedness; neutron and proton can be distinguished by $\beta_f = -1$ and $+1$, and the charge operator can be introduced as the generator of the symmetry group $\Psi' = \exp[i\alpha(\beta_f + 1)/2]\Psi$; 3) the bare nucleon necessarily has a mass spectrum; mass is conjugate to another measurable length λ associated with a nucleon, and states can be formed in which the unsharpness of the bare mass and of λ vary in a complementary way. The relevance of this new concept to the physical process of measuring the mass via interaction with other fields and to the renormalization of this nucleon field is discussed. (auth)

16206

BARYON MASS-DIFFERENCES AND SYMMETRIES OF STRONG INTERACTIONS. N. Dallaporta and L. K. Pandit (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 16, 135-67(1960) Apr. 1. (In English)

A scheme of the strong interactions of the baryons is given which takes account of the different baryon masses and has a high degree of symmetry without forbidding any of the known fast reactions. Only the usual fermion-fermion-boson type of interactions is employed. Starting with results obtained in papers A and B, which used the doublet approximation where the baryons are grouped into four isobaric doublets, four doublets are described by a 32-component spinor and their interactions are written using a 32×32 matrix. In A and B the K interaction, neglecting the mass differences, was taken to be an invariant under rotations in a 4-dimensional euclidean space called the hypercharge space, the K mesons being described by four real fields considered as the components of a vector in this space. The π interaction was, of course, invariant under rotations in the usual 3-dimensional isobaric spin space. Significant are the six generators of infinitesimal rotations in the hypercharge space, grouped here into two sets of quantities Y_i and Z_i ($i = 1, 2, 3$), which generate infinitesimal rotations in two different 3-dimensional subspaces of the hypercharge space, which are called, respectively, the hypercharge-spin space and the hypernumber-spin space (Y_i are called the hypercharge-spin operators and Z_i the hypernumber-spin operators). In A the N-Ξ mass difference was introduced by adding to the K interaction another term so that the resulting lagrangian was no longer invariant under rotations in the hypercharge-spin space. This interaction is invariant only under rotations about the third-axis of this space (this expresses the conservation of the hypercharge or the strangeness) and under any rotation in the hypernumber-spin space. The final step of introducing the Λ-Σ mass-splitting is carried through by taking for the final π and K interaction lagrangian a linear combination of the original one of A and the one obtained therefrom by interchanging the roles of the fictitious particles Y^0 and Z^0 ($Y^0 = (\Sigma^0 + \Lambda^0)/\sqrt{2}$, $Z^0 = (\Sigma^0 - \Lambda^0)/\sqrt{2}$). Then only four independent constants (F, F', g and b) enter the theory. It turns out that the various terms of the final lagrangian have exactly the same form as the terms of the d'Espangnat-Prentki lagrangian. The difference is that the eight coupling constants of the latter are now not independent, but are expressed in terms of only four parameters F, F', g, and b. The lagrangian now conserves neither the total hypernumber spin nor the total isobaric spin of the doublet approximation, but it does conserve the quantity obtained

as the vector sum of the two. This quantity is called the effective isobaric spin. It has exactly the same values for the different particles as the ones given by the Gell-Mann-Nishijima scheme. The isobaric spin space is identified with the hypernumber-spin space, and thus is considered as a subspace of the 4-dimensional hypercharge space. The theory is invariant under boson, spinor, and charge conjugation separately. Finally it is seen that the charge-state symmetries inherent in the theory are such that, assuming CP invariance, they automatically lead to P invariance. (auth)

16207

A THEOREM ON THE ELIMINATION OF CONTACT MUON-ELECTRON INTERACTIONS. N. Cabibbo, R. Gatto, and C. Zemach (Università e Scuola di Perfezionamento in Fisica Nucleare, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10) 16, 168-74(1960) Apr. 1. (In English)

A general theorem on the elimination of possible contact muon-electron interactions is given which includes as particular cases a theorem by Cabibbo and Gatto and a theorem by Feinberg, Kabir and Weinberg for particular types of interactions. (auth)

16208

THE ELECTRONIC DECAY OF Λ^0 DERIVED INDIRECTLY BY K-MESON COUPLINGS. D. Flamm (Universität, Vienna). Nuovo cimento (10) 16, 194-7(1960) Apr. 1. (In English)

The decay rate for $\Lambda^0 \to p \to e + \nu$ (Λ^0_{e3}) is calculated in two ways, using meson (K) couplings and vector-axialvector couplings. The two results are compared with each other and with the experimental value. (D.L.C.)

16209

ANOMALOUS MOMENT OF THE μ-MESON FOR DIFFERENT MODELS OF BREAKDOWN OF QUANTUM ELECTRODYNAMICS. B. De Tollis (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10) 16, 203-5(1960) Apr. 1. (In English)

The correction to the anomalous magnetic moment of the meson(μ) is calculated from possible modifications of the meson(μ) propagator and of the electromagnetic vertex due to breakdown of quantum electrodynamics at small distances. The corrections for these two cases and for possible modification of the photon propagator are tabulated as a function of the cutoff parameter, η. (D.L.C.)

16210

POSITRON ANNIHILATION IN AQUEOUS SOLUTIONS. Georg Trumpy (Institutt for Atomenergi, Lillestrøm, Norway). Phys. Rev. 118, 668-74(1960) May 1.

The angular correlation of 2-quantum emission from the annihilation of positrons in different materials was measured in an apparatus with 8 photon counters providing coincidences for 16 output channels. As positron targets were chosen indium, water, and aqueous solutions of 5 paramagnetic salts and 10 other substances. It was confirmed that the amount of singlet positronium formed is influenced by two processes: a reduction of positronium due to electron capture by oxidizing substances and an increase of the triplet → singlet conversion due to the electron exchange with paramagnetic ions. The oxidation potential of positronium is found to be very nearly zero. The conversion rate seems to be proportional to the number of unpaired electrons on the dissolved ions. A discrepancy with the interpretation of Green and Bell for their lifetime experiments is discussed. (auth)

16211

NUMERICAL EVALUATION OF THE PION-NUCLEON FORWARD SCATTERING AMPLITUDE. James W. Cronin (Princeton Univ., N. J.). Phys. Rev. 118, 824-7(1960) May 1.

The real part of the forward elastic scattering amplitude for $\pi^{\pm}$-proton scattering was evaluated from experimental cross sections by means of dispersion relations. Recent measurements indicate two peaks in the π^--proton total cross section at 590 and 870 Mev incident pion kinetic energy. Tables of the real part of the forward scattering amplitude for $\pi^{\pm}$-proton scattering are presented as a function of incident pion kinetic energy in the laboratory. The forward scattering amplitudes obtained from some recent $\pi^{\pm}$-scattering experiments are compared with the calculations. Measurement of the forward charge-exchange cross section appears to be the most suitable way of investigating the predictions of the dispersion relation at high energies. The possibility of detecting Coulomb interference at small angles is also discussed. (auth)

16212

NEUTRON FORM FACTORS FROM HIGH-ENERGY INELASTIC ELECTRON-DEUTERON SCATTERING. S. Sobottka (Stanford Univ., Calif.). Phys. Rev. 118, 831-8 (1960) May 1.

The inelastic electron-deuteron scattering cross section has been measured for incident electron energies between 300 Mev and 650 Mev and for final electron energies primarily at the maxima of the inelastic continua. The data were interpreted in terms of neutron form factors by employing the impulse approximation calculations of Goldberg. The results indicate that F^2_{2n} is nearly equal to the proton form factor F^2_p for $2.65 < q^2_p < 15.1$ (fermi)$^{-2}$ but may be 20% or 30% higher than F^2_p for the lowest of these q values. Uncertainties, primarily in the theory, make it impossible to determine whether the difference is real. The results also indicate that $-2.5 < F_{1n}/F_{2n} < 0.5$ for $5.1 < q^2 < 12.8$ f^{-2}. (auth)

16213

HIGH-ORBITAL S-STATE CAPTURE OF π^- MESONS BY PROTONS. T. B. Day, G. A. Snow, and J. Sucher (Univ. of Maryland, College Park). Phys. Rev. 118, 864-6(1960) May 1.

The consequences of the very short capture time for π^- mesons in liquid hydrogen, recently measured by Fields, Yodh, Derrick, and Fetkovich, are discussed. It is pointed out that collisional de-excitation mechanisms, even including the Stark effect enhancement of capture, seem inadequate to explain the experiment. Alternative possibilities are discussed. (auth)

16214

INTERFERENCE PHENOMENA IN NUCLEAR SCATTERING OF NEUTRAL K MESONS. Nripendra N. Biswas (Univ. of California, Berkeley). Phys. Rev. 118, 866-9 (1960) May 1.

The scattering of mesons (K^0) was treated phenomenologically. The scattered beam, in general, contains both K_0 and $\overline{K}_0$ components having different amplitudes. These amplitudes interfere with each other in the generation of K_1 and K_2 components in the scattered beam. The relative sign of the two amplitudes may then be determined from the analysis of K_1, K_2 decays. The leptonic decay rates of the scattered beam show a dependence on ΔM, the mass difference between K_1, K_2 in such a way that the sign of ΔM can, in principle, be determined experimentally. (auth)

16215

MUON CAPTURE IN He^3. Akihiko Fujii (Purdue Univ., Lafayette, Ind.). Phys. Rev. 118, 870(1960) May 1.

The hard-core wavefunction for a three-nucleon system

is used to calculate the capture rate of the reaction $\mu^- + He^3 \rightarrow H^3$ (ground state) + ν. It is found to be 1.66×10^3 sec^{-1}. (auth)

16216

T, P, C SYMMETRIES IN THE π^0 DECAY. Jeremy Bernstein and Louis Michel (Ecole Polytechnique, Paris). Phys. Rev. 118, 871-5(1960) May 1.

An analysis is given of the decay of the meson (π^0) in which allowance is made for possible breakdowns in T, P, and C symmetries. It is shown that experiments, until now, have demonstrated only that the two-photon state is an eigenstate of TP, but not of T and P separately. A discussion of experiments which may verify T and P symmetry for the two-photon state is given. (auth)

16217

QUANTUM MECHANICAL TRANSPORT THEORY. I. INCOHERENT PROCESSES. Kenneth M. Watson (Univ. of California, Berkeley). Phys. Rev. 118, 886-98(1960) May 15.

The transport of particles through a scattering medium is studied. A generalization of a technique due to Placzek and Wick is used to handle sums over states of excitation of the medium. The collision processes which occur are classified as "inelastic," "elastic," and "quasi-elastic" and correspond to different orderings of the Placzek-Wick series. The inelastic scatterings are described by an essentially classical transport equation and the elastic scatterings by assigning a refractive index to the medium. The "quasi-elastic" scattering involves the excitation of low-lying states of the scattering system. The coherent interference of waves scattered from nearby scatterers is important in this case and depends upon the structure of the medium. In this paper the general theory is developed in terms of a systematic sequence of approximations, of which the first gives just the classical form of transport theory. The correction terms then appear as quantum-mechanical corrections to the classical transport problem. (auth)

16218

RANDOM-WALK INTERPRETATION AND GENERALIZATION OF LINEAR BOLTZMANN EQUATIONS, PARTICULARLY FOR NEUTRON TRANSPORT. E. Guth and E. E. Inönü (Oak Ridge National Lab., Tenn.). Phys. Rev. 118, 899-900(1960) May 15.

The connection between linear recurrence relations which define generalized random walks and the related linear Boltzmann equations is clarified. The probability distribution $f_n(s)$ for "the state s" reached by a "random walker" after n steps satisfies the recurrence relation $f_{n+1}(t) = \int f_n(s)P(s,t)ds$, where the nonnegative P(s,t) is the probability of a transition from s to t. The Boltzmann distribution is given by $f(s) = \Sigma_{n=0}^{\infty} f_n(s)$. In general, $f_n(s)$ contains more information than $f(s)$. Moreover, $f_n(s)$ is the nth term in the iteration series solution of the Boltzmann equation and therefore can also be obtained from the solution of an associated Boltzmann equation which contains an additional parameter. As an example, the well-known integral Boltzmann equation for neutron transport in a nonmultiplying infinite medium is derived from a P(s,t) which involves a transition in a seven-dimensional phase-time space. Brownian motion and Rayleigh's problem (related to neutron thermalization) may be treated similarly. (auth)

16219

RANGE-ENERGY RELATIONS FOR PROTONS IN VARIOUS SUBSTANCES. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 118, 1045-8 (1960) May 15.

An expression is obtained for the range-energy relation $R(T_p)$ for protons (T_p = proton kinetic energy) as a function of the mean excitation potential I which enters into the Bethe-Bloch formula for the ionization loss dE/dx. The expression for $R(T_p)$ is obtained by an interpolation of the previously calculated range-energy relations for Be, Al, Cu, and Pb. The resulting expression for $R(T_p)$ can be used for any substance, provided an appropriate value of I is assumed. Values are also obtained for the quantity q = (I/R)(dR/dI) which gives the fractional change of R for a small variation of the excitation potential I. (auth)

16220

PROTON POLARIZATION IN p-d SCATTERING. S. M. Shafroth, R. A. Chalmers, and E. N. Strait (Northwestern Univ., Evanston, Ill.) and R. E. Segel (Aeronautical Research Lab., Dayton, Ohio). Phys. Rev. 118, 1054-9(1960) May 15.

The proton polarization resulting from proton-deuteron elastic scattering was measured in a double-scattering experiment. The first scattering took place in helium, which served as a polarizer, and the left-right asymmetry observed in a second scattering in deuterium. Spurious asymmetries were checked by substituting xenon and, separately, helium for deuterium as the second scatterer. Measurements taken at a proton-deuteron scattering energy of $E_p = 3.4$ Mev, $\theta = 45°$ and 90°, and $E_p = 3.74$ Mev, $\theta = 45°$ all yielded results consistent with no polarization. From these data it is concluded that the proton polarization in p-d elastic scattering is $<\sim 10\%$ in this energy region. (auth)

16221

MULTIPLE SCATTERING OF POLARIZED ELECTRONS. M. K. Sundaresan (Panjab Univ., Chandigarh, India). Phys. Rev. 118, 1072-3(1960) May 15.

The theory of multiple scattering derived earlier is used to evaluate the numerical magnitudes of the depolarization produced due to multiple scattering in gold foil of thickness 1 mg/cm^2 for polarized electrons of velocities: $v/c = 0.6$, 0.7, 0.8, 0.9. The depolarization effect is found to be extremely small. The correction due to multiple scattering to the electrostatic rotation of spins is also computed. (auth)

16222

PROTON-PROTON SCATTERING AT 25 Mev. T. H. Jeong, L. H. Johnston, and D. E. Young (Univ. of Minnesota, Minneapolis) and C. N. Waddell (Univ. of Southern California, Los Angeles). Phys. Rev. 118, 1080-1(1960) May 15.

The differential cross section for proton-proton scattering was measured for 23 center-of-mass angles from 10° to 90°, with ±0.8% absolute probable error at angles greater than 14°. The incident proton energy was 25.63-Mev lab. The 90° cross section is 18.59 millibarns, and the interference minimum of 17.09 mb occurs at 24° c.m. A set of phase shifts which fit the data are: $^1S_0$, 49.5°; $^3P_0$, 8.2°; $^3P_1$, −4.2°; $^3P_2$, 2.0°; $^1D_2$, 0.62°. (auth)

16223

SEARCH FOR AN ELECTRIC DIPOLE MOMENT STRUCTURE OF THE MUON. David Berley and George Gidal (Columbia Univ., New York). Phys. Rev. 118, 1086-91 (1960) May 15.

A search was made for an electric dipole moment in the muon with a sensitivity of 0.1% of a muon Compton wavelength times the electronic charge. The motivation for this investigation is provided by the interest in finding some property of the muon which would indicate a structure different from that of the electron, even though such a structure would violate both parity conservation and time

reversal invariance. The muons pass through the fringe field of the cyclotron and an additional system of magnets producing an electric field in their rest frame. Any electric dipole moment would precess about this field producing a vertical plane component of spin transverse to the momentum. This is detected by measuring the electron asymmetry in the plane perpendicular to the momentum. The absence of such a component within the stated sensitivity gives an upper limit to the electric dipole moment of the muons as 2×10^{-16} cm × the charge of the electron. (auth)

16224

CHARGE INDEPENDENCE IN THE REACTIONS $p + d \rightarrow \pi^0 + He^3$ AND $p + d \rightarrow \pi^+ + H^3$ AT 450 Mev. A. V. Crewe, B. Ledley, E. Lillethun, S. M. Marcowitz, and C. Rey (Univ. of Chicago). Phys. Rev. 118, 1091-4(1960) May 15.

An experiment was performed to measure the branching ratio in the production of He^3 and H^3 in p-d collisions at 450 Mev at 140° in the c.m. system. The result is 2.13 ± 0.15 which is in agreement with the prediction of a ratio 2 on the basis of charge independence alone. The production cross sections were found to be $(d\sigma/d\Omega)_{He^3} = 5.41 \pm 0.29$ μb/sr and $(d\sigma/d\Omega)_{H^3} = 11.55 \pm 0.49$ μb/sr. (auth)

16225

K^- ABSORPTION AND π-Σ PHASE SHIFTS. Richard H. Capps (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 118, 1097-9(1960) May 15.

The relations between $\overline{K} + N \rightarrow \pi + Y$ absorption amplitudes and pion-hyperon scattering amplitudes that are implied by the unitarity of the scattering matrix are considered. It has been shown by Kawarabayashi that if Λ production and the K^0–K^- mass difference are neglected, the zero kinetic energy K^-–p absorption data of the Berkeley hydrogen bubble chamber group imply that at least one of the angular momentum ½ pion-hyperon scattering amplitudes is much larger than are any of the j = ½ pion-nucleon amplitudes at a corresponding energy. It is demonstrated that the conclusion of Kawarabayashi remains valid if one includes the effects of Λ production and the K^0–K^- mass difference. (auth)

16226

REGENERATION AND MASS DIFFERENCE OF NEUTRAL K MESONS. Francis Muller, Robert W. Birge, William B. Fowler, Robert H. Good, Warner Hirsch, Robert P. Matsen, Larry Oswald, Wilson M. Powell, and Howard S. White (Univ. of California, Berkeley) and Oreste Piccioni (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 4, 418-21(1960) Apr. 15.

The regeneration of K1 from K2 neutral mesons and the mass difference between the two mesons were studied by passing a K^0 beam through 1.5- and 6-in. iron plates. About 200,000 pictures were made of the events, and they were analyzed for two-prong events where the primary momentum was equal to the beam momentum. The $Q(\pi,\pi)$ distribution of these selected events showed a peak around the expected value of 220 Mev, thus proving the regeneration of K1. The angular distribution of K1 decay events is plotted; the diffraction was computed from an optical model method and subtracted from the distribution to give the transmission peak, which was found to be confined to angles smaller than 2.5° (angle between primary K2 beam and regenerated K1). The mass difference is calculated to be zero for the 1.5-in. plate and 0.85 for the combination of the 1.5- and 6-in. plates. (D.L.C.)

16227

ANALYSIS OF THE EXPERIMENTAL τ'^+ DECAY SPECTRUM AS A TEST OF THE $\Delta T = \frac{1}{2}$ RULE. S. Bjorklund, E. L. Koller, and S. Taylor (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev. Letters 4, 424-5(1960) Apr. 15.

Re-analysis of 72 τ'^+ decays gave a value of –7.1 for $a_{\tau'}$ (a constant in the decay equation), which is in fair agreement with the value of –9.3 computed from the isotopic spin selection rule $\Delta T = \frac{1}{2}$. (D.L.C.)

16228

UPPER LIMIT FOR PRODUCTION OF Σ^-n HYPERFRAGMENTS BY K^- CAPTURE IN DEUTERIUM. Orin Dahl, Nahmin Horwitz, Donald Miller, and Joseph Murray (Univ. of California, Berkeley). Phys. Rev. Letters 4, 428-30 (1960) Apr. 15.

In order to determine the relative rates for production of bound and unbound Σ^-(n) states, 2100 such states obtained in two exposures of a deuterium bubble chamber to a K^- beam were examined. It is concluded that the percentage of Σ^- productions leading to formation of the bound state is less than 1%. The Σ^-(n) capture and identification of hyperfragments are discussed. (D.L.C.)

16229

TOTAL ABSORPTION RATE OF MUONS IN CARBON. F. Russell Stannard (Univ. of California, Berkeley). Phys. Rev. Letters 4, 523-4(1960) May 15.

The absorption rate was studied for muons in carbon with a 30-in. propane bubble chamber. The muon beam had a 1% pion background. Of the 2519 particles stopping in the chamber, 2334 decayed and 185 interacted. The pion contamination was estimated from prong distributions of pion and muon capture stars. It is expected that ~18% of muon captures lead to a formation of B^{12}, which β decays to C^{12}. If a decay lifetime of 2.22×10^{-6} sec is assumed, the estimate of the total capture rate becomes $\Lambda_1 = (0.36 \pm 0.04) \times 10^5$ sec^{-1}. (B.O.G.)

16230

MODIFIED ANALYSIS OF NUCLEON-NUCLEON SCATTERING. p-p PHASE SHIFTS AT 210 MEV. Malcolm H. MacGregor and Michael J. Moravcsik (Univ. of California, Livermore). Phys. Rev. Letters 4, 524-7(1960) May 15.

The modified phase-shift analysis was extended to measurements at 210 Mev. Two acceptable solutions were found, which correspond to two Stapp solutions at 310 Mev. Search problems were run from 30 random sets of phase shifts, using one-pion exchange with a coupling constant $g^2 = 14.4$ for G and higher waves, and searching on the 9 parameters S, P, D, F, ϵ_2. These yielded 7 solution sets with χ^2 less than 200. The χ^2 values of 115, 135, and 181 feature $^1S_0$ phase shifts larger than +30°, and are ruled out by comparison with the negative $^1S_0$ phase shift required at 310 Mev. The remaining sets show that the three largest angles in the differential cross section data contribute unreasonable values to χ^2. When corrections are applied, two of the solutions have about the expected χ^2 value of 26. The values of the coupling constants deduced from plots of the results of the 9-parameter search are $g^2 = 14.3 \pm 2.5$, 15.8 ± 2.4, 21.0 ± 3.8, and ~28 for the χ^2 values below 115. Curves of the p-p scattering parameters σ, D, R, A, C_n, and C_{kp}, predicted by four of the solutions together with data used in the analysis are shown. (B.O.G.)

16231

POSSIBLE EVIDENCE FOR THE RADIATIVE DECAY OF THE Σ^+ HYPERON. E. M. Friedländer (Inst. of Atomic Physics, Bucharest). Phys. Rev. Letters 4, 528-30(1960) May 15.

An event most likely interpreted as a three-body decay of a Σ^+ hyperon was found in an Ilford G-5 emulsion exposed

to the Bevatron K^- beam. Pertinent data for the tracks associated with the event are shown. If the Σ^+ decays at rest, the expected pion decay energy is 92.2 Mev, in striking disagreement with the value deduced from the observed range, 24 ± 1 Mev. This lower energy is possibly explained by collision without visible products before it stops and decays (the range of the decay muon proves that the π-μ decay occurred at rest). Measurements were made of constant sagitta scattering, total gap count, constant-cell scattering at C (the origin of the pion), and the gap count near C. The gap density ratio was found to be 1.03 ± 0.08, proving that the pion was emitted from C with an energy corresponding to its observed range. (B.O.G.)

16232

EVIDENCE FOR THE REACTION $p + p \rightarrow \bar{\Sigma}^0 + \Lambda$. Janice Button, Philippe Eberhard, George R. Kalbfleisch, Joseph E. Lannutti, Gerald R. Lynch, Bogdan C. Maglić, and M. Lynn Stevenson (Univ. of California, Berkeley). Phys. Rev. Letters 4, 530-3(1960) May 15.

An event was found in a 72-in. liquid hydrogen bubble chamber which was considered to be either the $\bar{p} + p \rightarrow \bar{\Sigma}^0 + \Lambda$ or $\bar{\Lambda} + \Sigma^0$ reaction. From the results of various measurements of momenta, direction, and χ^2 values, it was concluded that the observed reaction was $\bar{p} + p \rightarrow \bar{\Sigma}^0$. The Λ is produced at 10.6 ± 0.4° and the $\bar{\Lambda}$ at an angle of 4.6 ± 0.3° with respect to the incident antiproton. This reaction was observed once in ≈6000 antiproton interactions. The known total cross section is about 90 mb. This indicates that the $\Lambda + \bar{\Sigma}^0$ cross section is about 30 μb. (B.O.G.)

16233

π^- CAPTURE IN COMPLEX NUCLEI AND NUCLEAR PAIR CORRELATIONS. S. Ozaki, R. Weinstein, G. Glass, E. Loh, L. Neimala, and A. Wattenberg (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters 4, 533-5(1960) May 15.

Scintillation counters in coincidence were used as detectors of neutrons and protons produced in π^- capture by complex nuclei. By measuring neutrons, it was hoped to establish whether π^- capture in complex nuclei involves two nucleons, and if it does, to use the process to study the ratio of neutron–proton pairs to proton–proton pairs. The π^- mesons were stopped in Li, C, Al, S, Cu, and Pb targets. In order to test the spatial correlation of the ejected nucleons, measurements were made with the counters 90° and 180° from each other. The results obtained are given as coincidences as a function of angle. If corrections are made for relative probability of detecting neutrons and protons, the following ratios of n–n events (a) $[\pi^- + p + n \rightarrow n + n]$ to n–p events (b) $[\pi^- + p + p \rightarrow n + p]$ are obtained: carbon, a/b = 5.0 ± 1.5; aluminum, a/b = 3.9 ± 1.2. Due to background subtractions and secondary events contributing more to the proton coincidence runs, it is felt that these observed ratios are to be taken as lower limits on the ratio of reaction. (B.O.G.)

16234

ROLE OF THE π-π INTERACTION IN HIGH-ENERGY π-NUCLEON INTERACTIONS. P. Carruthers and H. A. Bethe (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters 4, 536-9(1960) May 15.

The salient features of π-N interactions at 0.5 to 1.5 Bev are described in that every interaction is initiated by the scattering of incident pions by virtual pions of the nucleon. From the behavior of the events it is clear that there must be a large π-π cross section. It is hoped to explain the "intermediate" energy region ($0.5 < E < 1.5$ Bev) in terms of pion physics for the 3-3 resonance and the large π-π cross section. The meson-plus-nucleon propagator is strongly enhanced by 3-3 resonance effects; for the channel with two p-wave mesons this amplitude probably displays a resonance (near 990 Mev). With the over-all behavior controlled by the π-π channel, the difference between the interactions of positive and negative mesons with protons may be understood. The resonance is considered as due to coöperation between 3-3 and a π-π resonance, of t = 0 or t = 1, respectively. Resonances were assumed to arise from the two-meson configuration S-P (and P-P). It is pointed out that this proposal explains why resonances exist in the $D_{3/2}$ (and $F_{7/2}$) state and not in $D_{5/2}$ (and $F_{5/2}$). From the vector model, the highest J obtainable from a state containing two mesons of orbital momenta l_1, l_2 and a nucleon of spin $s = 1/2$ is $J_{max} = l_1 + l_2 + 1/2$, which gives $J_{max} = 3/2(5/2)$ for the S-P (P-P) configuration. (B.O.G.)

16235

MULTIPLE GENERATION OF PARTICLES IN HIGHEST ENERGY NUCLEON COLLISIONS. Jerzy Bartke and Roman Holynski (Inst. of Nuclear Studies, Krakow). Postępy Fiz. 10, 309-39(1959) May-June. (In Polish)

A survey is given of published literature on the multiple generation of particles in nucleon–nucleon collisions. The review includes experimental data published in 1958 and earlier. Various jets are described and their relations to the phenomenological theories of Fermi, Landau, and Heisenberg are formulated. (B.O.G.)

16236

HYPERFRAGMENTS–REVIEW OF CERTAIN THEORETICAL PROBLEMS. Przemyslaw Zielinski (Inst. of Nuclear Studies, Warsaw). Postępy Fiz. 10, 341-61(1959) May-June. (In Polish)

A survey of hyperfragments and their properties is presented. Their formation, spin, structure, and strangeness are described. The discussion does not go beyond presently available facts. 134 references are included. (B.O.G.)

16237

DISPERSION RELATIONS IN THE QUANTUM FIELD THEORY. Zofia Bialynicka-Birula (Inst. of Physics, Polish Academy of Sciences, Warsaw). Postępy Fiz. 10, 409-23(1959) July-Aug. (In Polish)

The nature and application of dispersion relations in quantum field theory were surveyed. The dispersion of π mesons on nucleons was considered in light of the survey. An extensive bibliography is included. (B.O.G.)

16238

REACTION $p + d \rightarrow t + \pi^+$ AT PROTON ENERGY OF 670 Mev. Yu. K. Akimov, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 643-4(1960) Feb. (In Russian)

Cross sections of reactions $p + d \rightarrow t + \pi^+$ and $p + d \rightarrow He^3 + \pi^0$ at 670 Mev were measured in order to find conditions for correlating the two processes. Differential cross sections were calculated for incoming protons of 670 Mev and equal $d\sigma(12°)/d\Omega = 3.1 \times 10^{-30}$ cm^2/sterad, $d\sigma(25°)/d\Omega = 2.4 \times 10^{-30}$ cm^2/sterad. (R.V.J.)

16239

EXPERIMENTAL MEANS FOR VERIFYING FORMFACTORS IN THE UNIVERSAL THEORY OF FERMI-INTERACTIONS. Tsou-hsiu Ho (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret Fiz. 38, 648-50(1960) Feb. (In Russian)

Calculations are made on μ capture by nuclei with spin 1/2 without neutron or proton emission and with the assumption that following the capture the nuclei pass from

spin 1/2 to spin 3/2. Singlet-state capture is used as a form factor criterion. (R.V.J.)

16240

PULSE DISTRIBUTION OF PARTICLES PRODUCED IN INELASTIC NN-INTERACTIONS AT 9 Bev. V. S. Barashenkov, Wan P'ei, and V. M. Mal'tsev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 650-2(1960) Feb. (In Russian)

Theoretical and experimental spectra for particles produced in inelastic nucleon interactions (in the colliding nucleon center of inertia system) are plotted. The value $\bar{p}$ obtained by the analysis of proton interactions with emulsion nuclei is $\bar{p} \approx \bar{p}_{sp} = (3.0 - 0.5)$ Bev/c for protons and $\bar{p} \approx \bar{p}_{s\pi} = (1.0 - 0.2)$ Bev/c for π mesons ($\bar{p}_{sp}$ is the fast proton pulse: $\bar{p}_{s\pi}$ the fast π meson pulse). The experimental nucleon spectra is stronger and the π-meson spectra softer than the theoretical. The theoretical energy losses in the production of new particles per inelastic p-p interaction is about 58% of the initial nucleon energy (50% on π meson production and about 8% on strange particles), which is much higher than is shown by experimental data. (R.V.J.)

16241

ON RESONANCE π-π INTERACTION. V. M. Maksimenko (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 652-4(1960) Feb. (In Russian)

Experiments were made in order to find some evidence of resonance π-π interaction. An analysis is made of the angular π meson correlations for the case of stopped antinucleon annihilation in the scheme $\bar{p} + p$ (or $\bar{n} + n$) $\rightarrow \pi^+ + \pi^- + \pi^0$. (R.V.J.)

16242

ON THE APPLICABILITY OF FERMI-TELLER "Z LAW" TO URANIUM CONTAINING PHOTOEMULSION. G. E. Belovetskiĭ (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 38, 658-60 (1960) Feb. (In Russian)

Experimental studies were made of uranium fission by slow π mesons in order to verify the previously obtained P_f value of 0.18 to 0.5. Evaluations of P_f with various assumptions show that π-meson capture by various atoms in emulsions containing uranium has a tendency to follow the Fermi-Teller law. 200-μ NIKF-B photoplates filled with uranyl acetate were used in the experiments. The number of uranium nuclei was determined by α emission. The admixture of μ^- mesons was equal to 20%. The P_f of uranium nuclei by μ^- mesons did not exceed 3% and was incorporated in the final results. The results show that the probability of π-meson capture has a tendency of following the "Z law" in proportion to the number of atoms. The data hold also for other mesons as atomic shell capture of mesons does not depend on the properties of the mesons. Consequently, the data obtained correlated with published data indicate that the probability of meson capture by various atoms in heterogeneous media depends on the structure of the medium. (R.V.J.)

16243

ON THE PRODUCTION OF ELECTRON-POSITRON PAIR NEUTRINO IN NUCLEAR FIELD. A. M. Badalyan and Kuang-chao Chou. Zhur. Eksptl'. i Teoret. Fiz. 38, 664-5 (1960) Feb. (In Russian)

An analysis was made of electron-positron pair neutrino production in nuclear fields. Formulas are developed for simplifying calculations of neutrino scattering cross sections. (R.V.J.)

16244

THEORY OF ELEMENTARY PARTICLES. Paul Roman. New York, Interscience Publishers Inc., 1960. 585p.

A treatment of elementary particles on a textbook basis is given in the following topics: mathematics of elementary particle theory (group theory), field equations, quantization of fields, invariance properties and selection rules (parity, etc.), and questions of isobaric spin. (D.L.C.)

Nuclear Properties and Reactions

16245 NP-8671

Lockheed Nuclear Products, Marietta, Ga.

NEW TYPE THRESHOLD DETECTOR REACTIONS. H. C. Price, Jr. Appendix: ISOTOPE THRESHOLDS ARRANGED BY ENERGY. Gloria Poss, comp. Jan. 1960. 71p. Contract AF33(600)-38947. (NR-85).

A new method for determining neutron spectra is described. The first phase of this investigation—that of surveying the methodology, its applications and utility, and the nuclear reactions which may potentially be employed in this work—is treated in some detail. Subsequent phases of the study are outlined, and fairly closely defined areas needing further research are set forth. The potential utilization of a large body of nuclear reactions not known to have been previously utilized for threshold detector work in the measurement of neutron spectra is treated. Useful catalogue-type information on these threshold reactions is included. These nuclear data are arranged in order of increasing threshold energies for best utilization in the present program. In the categories given, these tables include the major part of the current knowledge about the many reactions induced by impinging neutrons leading to charged-particle production. (auth)

16246 NYO-2239

Carnegie Inst. of Tech., Pittsburgh.

DECAY OF μ^- MESONS BOUND IN THE K-SHELL OF LIGHT NUCLEI. H. Überall. Feb. 1960. 43p. Contract AT(30-1)-882. OTS.

For μ^- mesons bound in the K-shell of light nuclei of atomic number Z, the decay electron spectrum was calculated up to the first power in Z, both for point and extended nuclei. The decay rate was evaluated up to second power for point nuclei. The results for the spectrum show the Doppler smearing of its upper end and demonstrate the small effect of the nuclear extension. The decay rate was obtained as a monotonically decreasing function of Z. It was found that the decay rate in second order decreased much more slowly with Z than what would be obtained from a phase space consideration alone. (auth)

16247 UCRL-9105

California. Univ., Berkeley. Lawrence Radiation Lab.

COINCIDENCE MEASUREMENTS IN NUCLEAR DECAY SCHEME STUDIES (thesis). John P. Unik. Mar. 1960. 105p. Contract W-7405-eng-48. OTS.

The decay schemes of the isomers of Tc^{95} and Tc^{97} were studied by using high-resolution conversion-electron spectrographs, gamma-ray scintillation detectors, and coincidence techniques. The half life of the 74.6-kev excited state in Np^{239} was measured by the delayed coincidence technique as 1.2 ± 0.1 mμsec. The directional correlations of two gamma-ray cascades following the beta decay of U^{237} to Np^{237} were studied and the results were found to be consistent with previous assignments of the total angular momenta of the excited states. An upper limit on the half life of the 332-kev excited state in Np^{237}

was determined to be 1.0 mμsec. Electron-electron coincidence measurements were performed on the beta decay of Pa^{233}. The transmission of one-half of the original electron-electron coincidence spectrometer was increased by a factor of six without sacrificing resolution. This increased transmission was achieved by converting the original thin-lens magnetic field to a thick-lens triangular magnetic field. (auth)

16248 UCRL-9123

California. Univ., Berkeley. Lawrence Radiation Lab. THE NUCLEAR SPINS AND MOMENTS OF SEVERAL RADIOACTIVE GALLIUM ISOTOPES (thesis). Vernon James Ehlers. Mar. 18, 1960. 115p. Contract W-7405-eng-48. OTS.

An atomic-beam magnetic-resonance technique with radioactive detection was used to investigate several radioactive gallium isotopes. The nuclear spin of 21-min Ga^{70} was determined to be 1, and the hyperfine structure separations of 68-min Ga^{68} and 78-hr Ga^{67} were measured. The Ga^{67} was measured in both the $^2P_{3/2}$ and the $^2P_{1/2}$ electronic states and the differential hyperfine structure anomaly $^{67}\delta^{69}$ determined. The Ga^{68} was measured in the $^2P_{3/2}$ state and exhibited a very small magnetic moment, causing an inversion of the energy levels. For an assumed positive magnetic moment the decreasing energy level sequence is F = 5/2, 1/2, 3/2. The nuclear moments were obtained by the use of the Fermi-Segrè formula and previously measured moments and interaction constants of Ga^{69}. (auth)

16249

STUDY OF SOME EXCITED LEVELS OF B^{11} BY THE METHOD OF ANGULAR DISTRIBUTIONS AND CORRELATIONS FROM STRIPPING. Michel Croissiaux. Ann. phys. (13) 5, 409-67(1960) Mar.-Apr. (In French)

The method of angular correlations and distributions from stripping was applied to the study of the properties of excited levels of B^{11} from the B^{10}(d,p) reaction. The distributions and corresponding correlations of the levels at 4.46, 5.03, 6.76, 6.81, and 7.30 Mev were measured. The excitation curve of the B^{10}(d,p) reaction was also determined for the first four levels—the ground level and the 2.14, 4.46, and 5.03 Mev levels. The γ-γ angular correlations from the 9.19 and 9.28 Mev levels of B^{11} were also studied. The mixture of multipolarities of the γ radiation at 4.46 Mev is defined and the various possibilities for the 6.76 Mev level are discussed. The parity of the 7.30-Mev level was determined and the limits to its spin are given. (tr-auth)

16250

THE DECAY OF Tl^{201}. C. J. Herrlander, R. Stockendal, and R. K. Gupta (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 17, 315-35(1960). (In English)

Using beta- and gamma-spectroscopic techniques, the decay of Tl^{201} was investigated. The half life of Tl^{201} was remeasured to be (73.5 ± 0.8) h. From internal conversion measurements in a double-focusing beta spectrometer, the energies of the four transitions previously known were found to be 30.60, 32.19, 135.34, and 167.43 kev. In addition, conversion lines of a new, weak transition of energy 165.88 kev were detected. From the measured conversion ratios the multipolarities of all the transitions were proved to be M1, although, for the 165.88 kev transition, an E2 admixture of up to 7% cannot be excluded. A further proof of the multipolarity assignments of the 135.34 and 167.43 kev transitions was obtained from a determination of absolute internal conversion coefficients using the method of external conversion. Electron-gamma and gamma-gamma coincidence measurements were performed. The collected experimental information is in agreement with the following level sequence: 3/2 − (0 kev), 5/2 − (1.57 kev), 3/2 − (32.19 kev), and 3/2 − (167.49 kev); or 3/2 − (0 kev), 1/2 − (1.57 kev), 1/2 − or 3/2 − (32.19 kev), and 1/2 − or 3/2 − (167.49 kev). Electron-capture branching ratios are given. The investigation also gives information about relative intensities of the KLL Auger lines in mercury, and relative photo cross sections for L subshells of uranium, $(\tau_{L_I} + \tau_{L_{II}})/\tau_{L_{III}}$. The experimental results are in both cases compared with theoretical calculations. (auth)

16251

ON THE DETERMINATION OF THE ELECTRON-CAPTURE DECAY ENERGIES OF Tl^{201} AND Tl^{202}. R. K. Gupta (Nobel Inst. of Physics, Stockholm). Arkiv Fysik 17, 337-42(1960). (In English)

The decay energy of Tl^{201} was calculated by deducing the ratio between the probabilities of L_I- and K-electron capture to the 167 kev state in Hg^{201} from the number of coincidences between the 167 kev gamma ray and the K x rays. The value of the total decay energy was found to be 405^{+70}_{-40} kev. In a similar way the total decay energy of Tl^{202}, calculated from the number of coincidences between the 965 kev gamma ray and the K x rays, was found to be 1110 ± 20 kev. (auth)

16252

THE DECAY OF As^{76} TO Se^{76}. G. Bäckström and I. Marklund (Inst. of Physics, Uppsala). Arkiv Fysik 17, 393-409(1960). (In English)

The gamma rays were investigated by means of a double focusing spectrometer and a scintillation apparatus. Transitions of the following energies (kev) and relative intensities were found: 559.28 ± 0.10 (100), 657.36 ± 0.15 (14.1), 767.9 ± 2 (0.17), 869.1 ± 2 (0.24), 1216.0 ± 0.4 (9.7), 1228.7 ± 0.5 (2.3), 1438.3 ± 1.0 (1.2), 1453.5 ± 1.4 (0.54), 1788.6 ± 1.2 (0.71), 2097.2 ± 1.0 (1.32), 2111.8 ± 1.2 (0.73), 2433.6 ± 3 (0.05), 2656.1 ± 1.5 (0.077). Coincidence spectra were taken with two NaI(Tl) detectors, and the results were analyzed quantitatively. The decay scheme proposed involves levels at 559.3, 1216.6, 1788, 2112, 2434, and 2656 kev. The highest excited state is now known to have the spin of 3, and the ft-value as well as the presence of a detectable ground state transition indicate that the parity is odd and that the level should be considered as produced by octupole vibration. (auth)

16253

ANGULAR CORRELATION MEASUREMENTS ON LEVELS IN Se^{76} AND Fe^{56}. Z. Grabowski, S. Gustafsson, and I. Marklund (Inst. of Physics, Uppsala). Arkiv Fysik 17, 411-19(1960). (In English)

The angular distributions of cascading gamma rays in Se^{76} and Fe^{56} were investigated with an automatic directional correlation apparatus. The measured cascades in Se^{76} are (kev): 560 to 660, 560 to 1220, 560 to 2100, 1220 to 1220, 1220 to 1440, giving the following spins of energy levels in Se^{76}, kev (I, π): 560 (2+), 1216 (2+), 1788 (2+), 2434 (3), 2556 (3−). The first three levels may be of one, two and three phonon vibrational character respectively, and the 2656 kev level is of probable octupole vibrational type. The cascades 0.85 to 3.26, 1.24 to 2.02, and 1.24 to 1.76 Mev in Fe^{56} give a 3+ spin to the 4.10 Mev level and a (5+) spin level at 3.84 Mev. The spin assignment of the 4.10 Mev level is unique 3+, but it is in discrepancy with the interpretations of earlier correlation measurements. (auth)

16254

A DELAYED COINCIDENCE MEASUREMENT OF THE 2.9 10^{-10} SEC. HALF-LIFE OF THE 279 kev FIRST EXCITED STATE IN THALLIUM 203. E. Bashandy, T. R. Gerholm, and J. Lindskog. Arkiv Fysik 17, 421-6(1960). (In English)

The half life of the 279 kev first excited level in Tl^{203} has been remeasured by the delayed coincidence technique. An electron-electron coincidence spectrometer was used for the energy resolution. A half life of $(2.9 \pm 0.2) \cdot 10^{-10}$ sec has been obtained, in good agreement with earlier results from delayed coincidences, nuclear resonance, and Coulomb excitation measurements. The reduced transition probability for the E2 transition and the matrix element for the M1 transition were calculated and compared with those obtained from the single particle model. (auth)

16255

THE CROSS SECTION OF $^{232}Th(n,2n)^{231}Th$ AT 14 Mev. Yu. A. Zysin, A. A. Kovrizhnykh, A. A. Lbov, and L. I. Sel'chenkov. Atomnaya Energ. 8, 360-1(1960) Apr. (In Russian)

A method based on the measurement of Th^{231} activity and fission product of Mo^{99} and Ba^{140} was used for determining the cross sections for $Th^{232}(n,2n)$ reactions of 14.7 Mev. The method does not require measurements of absolute neutron flux but requires data on the fission cross section and yields of γ_{Mo} and γ_{Ba} fragments. The results showed $\sigma \frac{Th}{n,2n} = (0.65 \pm 0.15)$ barn, in good agreement with data developed from the yields from Mo^{99}, Ce^{141} ($\gamma \frac{Th}{Mo} = 0.20$; $\gamma \frac{Th}{Ce} = 0.059$), and other fragments in Th^{232} fission by 14.3 Mev neutrons. (R.V.J.)

16256

THE γ-RAYS GENERATED IN ^{238}U BY 14 Mev NEUTRONS. A. I. Veretennikov, V. Ya. Averchenkov, M. V. Savin, and Yu. A. Spekhov. Atomnaya Energ. 8, 361-3(1960) Apr. (In Russian)

The time-of-flight method was used in measuring the γ spectra and the number of γ quanta per interaction of 14-Mev neutrons with U^{238}. (R.V.J.)

16257

THE TABULATION OF THREE FUNCTIONS ARISING IN NUCLEAR RESONANCE THEORY. J. L. Cook and D. Elliott (New South Wales Univ., Kensington). Australian J. Appl. Sci. 11, 16-32(1960) Mar.

Tabulations to 5-D are given of three functions:

$$\psi(x,t) = \frac{1}{2\sqrt{(\pi t)}} \int_{-\infty}^{\infty} \frac{\exp[-(x-y)^2/4t]}{1+y^2}\, dy,$$

$$\phi(x,t) = \frac{1}{2\sqrt{(\pi t)}} \int_{-\infty}^{\infty} \frac{y \exp[-(x-y)^2/4t]}{1+y^2}\, dy,$$

and

$$\psi_n(t) = \int_{-\infty}^{\infty} \psi^n(x,t)dx.$$

The values of both ψ and ϕ are given for $\zeta = 0(0.05)1$ and for $t = 0(0.025)0.2(0.05)1(0.1)2$, where $\zeta = x/(1+x)$. Values of $\Psi_n(t)$ are given for $n = 1(1)10$ and for $t = 0(0.025)0.2(0.05)1(0.1)2$. (auth)

16258

STUDY OF THE 4.46- AND 5.03-Mev LEVELS OF B^{11} BY THE $B^{10}(d,p)B^{11}$ REACTION AT $E_d = 4.6$ Mev. Serge Gorodetzky, Michel Croissiaux, Pierre Fintz, Jacques Samuel, Gabriel Bassompierre, Raymond Armbruster, and Pierre Chevallier. Compt. rend. 250, 2874-6(1960) Apr. 25. (In French)

The measurements of the angular correlations and distributions in the $B^{10}(d,p)B^{11}$ reactions have shown that the contribution of the stripping is very weak at $E_d = 1.25$ Mev. The same study was made at $E_d = 4.6$ Mev. The results show no significant contribution by stripping. (tr-auth)

16259

CONVERSION ELECTRON SPECTRA (LOW ENERGIES) AND THE AUGER SPECTRA (L,M,N) EMITTED DURING THE β TRANSMUTATION OF PROTACTINIUM-233. Georgette Albouy and Manuel Valadarès. Compt. rend. 250, 2877-9(1960) Apr. 25. (In French)

The study of the electron spectrum emitted during the transmutation $Pa^{233} \rightarrow U^{233}$ was extended to the energy 0.2 kev. The results are tabulated. (tr-auth)

16260

POWER REACTORS. PLANTS OF THE NATURAL URANIUM–GRAPHITE–GAS TYPE. Pierre Bourgade and Michel Coudray (Indatom, Paris). Énergie nucléaire 2, 84-92(1960) Mar.-Apr. (In French)

A review is given of the principal problems in the design of a nuclear power plant with a graphite-moderated, natural uranium reactor. A judicious choice of solutions in the classical as well as in the nuclear range leads to an optimum reactor design. The particular technological and solid-state physical problems encountered in reactor design are discussed. The conditions for the exploitation of nuclear power plants are examined and an estimation is given of their cost. (J.S.R.)

16261

NEW LIGHT ISOTOPES OF THALLIUM PRODUCED BY BOMBARDMENT OF TUNGSTEN WITH NITROGEN IONS. K. F. Chackett and G. A. Chackett (Univ. of Birmingham, Eng.). J. Inorg. & Nuclear Chem. 13, 1-4(1960) Apr. (In English)

Two new thallium isotopes of half lives 10 min and 30 min were found among products of the bombardment of tungsten with nitrogen ions in the Nuffield cyclotron of the University of Birmingham. Identification and mass assignments depend on the decay curves of radiochemically separated samples. The 10 min activity is assigned to Tl^{191} and the 30 min activity to Tl^{193}. Decay proceeds almost entirely by electron capture; α-particle emission was not detected. (auth)

16262

CROSS-SECTIONS FOR THE REACTIONS $Ra^{226}(n,2n)Ra^{225}$ and $Ra^{226}(n,3n)Ra^{224}$ WITH 14.5 Mev NEUTRONS. L. P. O'Connor and J. L. Perkin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. & Nuclear Chem. 13, 5-12(1960) Apr. (In English)

About 5 mg of Ra^{226} were irradiated with 14.5 Mev neutrons. The products of the $Ra^{226}(n,2n)Ra^{225}$ and $Ra^{226}(n,3n)Ra^{224}$ reactions were determined by isolating Pb^{209} and Bi^{212} from their respective decay chains. Pb^{209} was isolated by separating Bi^{213} from the radium by means of an electrochemical deposition and then allowing Pb^{209} to grow in from its decay chain. Pb^{209} was then separated and its β-particle activity was counted in a 4π proportional counter. Bi^{212} was obtained by an electrochemical deposition following an electrolytic deposition of Pb^{212}. The α-particle activity of Bi^{212} was counted in a gridded ionization chamber. The values found for the cross-sections are as follows: Ra^{226} $\sigma(n,2n) = 1.60 \pm 0.20$ barn; Ra^{226} $\sigma(n,3n) = 0.63 \pm 0.07$ barn. (auth)

16263

DECAY CHARACTERISTICS OF POTASSIUM-42 AND TELLURIUM-132. C. Gatrousis and C. E. Crouthamel (Argonne National Lab., Lemont, Ill.). J. Inorg. & Nuclear Chem. 13, 13-17(1960) Apr. (In English)

The γ-spectra of potassium-42 and tellurium-132 were examined with a sodium iodide crystal spectrometer. A recently reported 53 kev γ-transition was observed in the decay of tellurium-132. Coincident summing in a single sodium iodide crystal at high geometry is used to reveal the main features of the relatively simple γ-decay schemes. (auth)

16264

EXPERIMENTAL STUDY OF THE ELECTRON SPECTRUM FOR AUTOIONIZATION IN BETA RADIOACTIVITY. F. Suzor (Laboratoire de Physique Nucléaire, Orsay, France). J. phys. radium 21, 223-8(1960) Apr. (In French)

Following already published experiments on P^{32}, S^{35}, Pm^{147}, results are given for Y^{90}, Pr^{143}, and Na^{22}. The intensities of the X, K or L lines, are in good agreement with the theory of autoionization. On the other hand the continuous spectra, between 1 and 13 kev, of autoionization electrons emitted simultaneously with β radiation disagree with theoretical predictions. The intensity is greater, the spectral distribution is different, and the law of variation versus Z is inverted. This could be explained by a contribution from external electronic shells considerably more important than that predicted by the autoionization theory. (auth)

16265

LIFETIMES OF LEVELS OF Sn^{116}. Rae Stiening and Martin Deutsch (Massachusetts Inst. of Tech., Cambridge). J. phys. radium 21, 261(1960) Apr. (In French)

In studies of slow coincidences in the γ rays of Sn^{116} from decay of In^{116+} (53 min), a line of 2.15 Mev energy followed by a 0.41 Mev line with a period of 10 ± 1 nanoseconds. An experiment to verify these coincidences is described. The intensity of a cascade with a lifetime of 10^{-8} sec should be below 2% of the total intensity. At least 75% of the coincidences have a period below 0.5 nanoseconds. (T.R.H.)

16266

MEASUREMENT OF COBALT-60 AND CESIUM-137 GAMMA RAYS WITH A FREE-AIR CHAMBER. H. O. Wyckoff. J. Research Natl. Bur. Standards 64C, 87-97 (1960) Apr.-June.

Design data for free-air chambers measuring cobalt-60 and cesium-137 gamma rays in roentgens are presented. It has been shown that the Jaffé-Zanstra method of obtaining the saturation current is adequate for air pressures of about 4 to 12 atmospheres. Also, radiation measurements of the gamma rays from cobalt-60 and cesium-137 made by a cavity chamber and a free-air chamber agree to within the experimental errors. (auth)

16267

THE NEUTRON SPECTRUM OF A Po-α-O SOURCE. A. G. Chabachpašev. Kernenergie 3, 392-4(1960) Apr. (In German)

The neutron energy spectrum of a Po-α-O source was measured. A HNO_3 solution of Po was used with water 24% enriched in O^{18}. A thin-walled stainless steel tube of the solution contained 2.3 cc which had an activity of 1.38c. The calculated neutron yield was 30.7 per 10^6 α particles. For the spectrum measurements a scintillation spectrometer setup was used which is described. The resulting neutron spectrum has a maximum at 2.4 Mev and the maximum neutron energy was 4.3 Mev. The spectral measurements were made over a 20-hour period; total spectrometer effectiveness, i.e., ratio of number of recorded pulses to number of emitted neutrons, was 10^{-6}. (T.R.H.)

16268

ULTRA-HIGH RESOLUTION γ-RAY RESONANCE IN ZINC-67. D. E. Nagle, P. P. Craig, and W. E. Keller (Los Alamos Scientific Lab., N. Mex.). Nature 186, 707-8(1960) May 28.

Observation is reported of nuclear resonance absorption of the 93 kev, 9.4 μ sec gamma ray of zinc-67. (C.H.)

16269

CONVERSION ELECTRON SPECTRUM FROM Ce^{144} DECAY. J. S. Geiger, R. L. Graham, and G. T. Ewan (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nuclear Phys. 16, 1-26(1960) Apr. (In English)

The internal conversion electron spectrum following the β decay of Ce^{144} was studied in the Chalk River iron-free $\pi\sqrt{2}\beta$ spectrometer at a momentum resolution of ≈0.1%. The 33 conversion lines observed are identified with 7 transitions of energies (in kev) and multipolarities 33.57 ± 0.03, M1; 40.93 ± 0.03, M1; 53.41 ± 0.03, M1; 59.03 ± 0.03, M3; 80.12 ± 0.03, M1; 99.95 ± 0.03, E2; and 133.53 ± 0.03, M1. The multipolarity assignment for each transition was obtained by comparing the observed conversion line intensity ratios with the theoretical line intensity ratios of Sliv. The intensity of the K conversion line of the 133.53 kev transition was measured relative to the total intensity of the Pr^{144} β spectrum; $I_{K\,133}/I_{Pr\,\beta\,sp.} = 0.053 \pm 0.002$. The momentum ratio of the Ce^{144} K 133.53 and Cs^{137} K 661.6 lines, corrected for electron energy loss in the Ce course, is $B_{\rho K\,133}/B_{\rho K\,661} = 0.31495 \pm 0.00003$. Intensity limits are placed on all previously reported Ce^{144} conversion lines not presently observed. Relative quantum intensities and total transition intensities are deduced from the conversion line data. A decay scheme for Ce^{144} is given which satisfactorily accounts for all the results of this investigation and is compatible with the results of earlier workers when some line reassignments are made. Interpretations of the Pr^{144} levels, established in this work, are discussed in terms of both the shell model and the unified model. With $\delta \approx +0.07$, the unified model accounts for the experimental evidence in a simple but convincing fashion. (auth)

16270

MULTIPLICITY OF RESONANCE NEUTRON CAPTURE GAMMA RAYS. J. E. Draper and T. E. Springer (Yale Univ., New Haven). Nuclear Phys. 16, 27-37(1960) Apr. (In English)

Measurements of the multiplicity of resonance neutron capture gamma rays are reported for 23 resonances of 15 nuclides in the range A = 110 to 198 by comparison with the known multiplicity for $B^{10}(n,\gamma)$. Multiplicities of two resonances forming Eu^{152}, two resonances forming Er^{168}, three resonances forming Lu^{177} and two resonances forming Hf^{178} were not dependent on resonance energy within the limits of experimental uncertainty. Significant variations were found among the multiplicities of three resonances forming In^{116} and two resonances forming Sm^{150}. There is some evidence that J = 3 for the 3.9-ev resonance forming Ho^{166}. Direct measurements of the resonance J values are not yet available for comparison. (auth)

16271

GAMMA RAYS FROM THE 4.24 Mev STATE IN MAGNESIUM-24. R. Batchelor, A. J. Ferguson, H. E. Gove, and A. E. Litherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys. 16, 38-51(1960) Apr. (In English)

The $Mg^{24}(p,p'\gamma)Mg^{24}$ reaction was studied in the proton energy range from 5 to 6 Mev. The yield of 4.24 Mev γ-rays shows two resonances, at 5.24 and 5.72 Mev, corresponding to states in Al^{25} at 7.30 and 7.77 Mev. The total widths of these resonances are 100 ± 20 and 340 ± 50 kev. Angular distributions and correlations of the γ-rays from

the 4.24 Mev state of Mg^{24} measured at the 5.72 Mev resonance show that the 4.24 Mev state has spin 2. Spins of 1 and 3 are eliminated by the measurements. The spin of the 7.77 Mev state of Al^{25} is most probably $^5/_2$. The measured branching ratio of the γ-rays from the 4.24 Mev state to the ground and 1.37 Mev states is (2.9 ± 0.5) : 1 and the E2/M1 amplitude ratio for the 2.87 Mev transition is +23 ± 9. These data give qualitative support to the collective model but there are quantitative disagreements with the detailed predictions for both axially symmetric and asymmetric nuclei. (auth)

16272

THE ELASTIC SCATTERING OF 19 Mev DEUTERONS BY KRYPTON AND XENON. J. B. A. England and R. McKeague (Queen's Univ., Belfast) and P. E. Hodgson (Clarendon Lab., Oxford). Nuclear Phys. 16, 52-8(1960) Apr. (In English)

Experimental measurements of the elastic differential cross-sections for the scattering of 19 Mev and 19.5 Mev deuterons from krypton and xenon were made using a nuclear emulsion plate camera. The results are compared with calculations using the optical model of the nucleus. The values of the parameters giving the best fit to the experimental results and the sensitivities of the calculated reaction cross-sections to these parameters are discussed. (auth)

16273

NUCLEAR RESONANCE FLUORESCENCE WITH THE 105-kev E1 TRANSITION OF Gd^{155} USING AN ULTRACENTRIFUGE. B. I. Deutch, F. R. Metzger, and F. J. Wilhelm (Franklin Inst., Swarthmore, Penna.). Nuclear Phys. 16, 81-9(1960) Apr. (In English)

Resonance fluorescence from the 105-kev level in Gd^{155} was studied with the centrifuge method. Assuming a branching ratio $\Gamma_0/\Gamma = 0.69$ for this E1 transition to the ground state, a mean life $\tau_\gamma = 6.0^{+6}_{-2} \times 10^{-10}$ sec was calculated from the measured resonance scattering at different source velocities. This lifetime and τ_γ of the 87-kev level measured by Vergnes are consistent with the E1 lifetime predictions of the Nilsson model if the 87-kev orbital is $[651^3/_2]$ and the 105-kev orbital is $[643^5/_2]$ at a nuclear deformation $\delta \approx 0.26$. (auth)

16274

THE PHOTONUCLEAR REACTIONS (γ,d) AND (γ,np) ON K^{39}. P. Horvat, J. Pahor, and M. Vakselj ("J. Stefan" Inst., Ljubljana, Yugoslavia). Nuclear Phys. 16, 90-1 (1960) Apr. (In English)

Argon-37 was identified as the product of (γ,d) and (γ,np) reactions on potassium-39. The combined yield curve of these reactions was measured for x-rays of 20 to 25 Mev maximum energy. A proportional counter technique for gaseous sources was used for spectrum identification and for yield curve measurements. (auth)

16275

COULOMB EXCITATION OF Li^7, F^{19}, AND Na^{23} BY Ne^{20} IONS. P. H. Stelson and F. K. McGowan (Oak Ridge National Lab., Tenn.). Nuclear Phys. 16, 92-8(1960) Apr. (In English)

Ne^{20} ions of 9 to 11 Mev obtained by the acceleration of doubly charged ions in the ORNL 5.5 Mv Van de Graaff were used to study Coulomb excitation in light nuclei. Excitation of the following states was observed: Li^7, 478 kev; F^{19}, 110 and 197 kev; Na^{23}, 440 kev. Absolute values for the reduced electromagnetic transition rates were obtained with an accuracy of ±20%. (auth)

16276

ISOTOPE SHIFT AND NUCLEAR DEFORMATIONS. A. S. Meligy, S. Tadros, and M. A. El-Wahab (Univ. of Alexandria, Egypt). Nuclear Phys. 16, 99-104(1960) Apr. (In English)

The expression for the isotope shift obtained previously by considering the nucleus as a sphere in which the charge distribution has the trapezoidal shape is refined and used to calculate the isotope shift constants for isotopic pairs for which experimental results are available. The isotope shift constants due to nuclear deformation were computed taking the deformations from the measured B(E2) transition probabilities. The calculated and experimental results of the isotope shifts of various elements are found to be in agreement within experimental uncertainties. On this evidence, the deformations of a number of nuclei were deduced from the isotope shift data. (auth)

16277

COMPARISON ON ASYMMETRIC QUADRUPOLE ROTOR ENERGY LEVEL PREDICTIONS FOR EVEN NUCLEI WITH EXPERIMENTAL RESULTS. C. A. Mallmann and A. K. Kerman (Argonne National Lab., Lemont, Ill.). Nuclear Phys. 16, 105-12(1960) Apr. (In English)

The asymmetric quadrupole rotor energy predictions, taking into account the interactions of the rotations with the beta vibrations, are compared with experimental results. The agreement between experiment and theory is good for nuclei with $R_e(^14+) = [E_e(^14+)/E_e(^12+)] \cong {}^{10}/_3$. Even parity energy levels of nuclei with $R_e(^14+) < {}^{10}/_3$ are not explained adequately. (auth)

16278

ANGULAR CORRELATION OF THE 1.07–1.24 Mev GAMMA CASCADE IN THE DECAY OF Ga^{68}. M. K. Ramaswamy and P. S. Jastram (Ohio State Univ., Columbus). Nuclear Phys. 16, 113-18(1960) Apr. (In English)

The angular correlation was measured of the 1.07 to 1.24 Mev gamma-ray cascade in Zn^{68} following the decay of 68-min Ga^{68}. The Legendre polynomial expansion coefficients were determined to be $A_2 = 0.31 \pm 0.03$ and $A_4 = 0.23 \pm 0.07$. The measured correlation establishes the spin sequence to be 2-2-0, with a quadrupole-dipole mixing ratio δ of +18 ± 0.2 for the 1.24-Mev gamma-ray. The result of the angular correlation work together with the allowed nature (log ft = 5.7) of the electron-capture decay to the 2.3-Mev level fixes the spin and parity of this level to be 2^+. The results are consistent with the near-harmonic model of Scharff-Goldhaber and Weneser for even nuclei. (auth)

16279

STUDY OF HEAVY ODD-MASS INDIUM ISOTOPES FROM THE (γ,p) REACTION ON TIN. H. Yuta and H. Morinaga (Tôhoku Univ., Sendai). Nuclear Phys. 16, 119-37(1960) Apr. (In English)

A series of bombardments using 25-Mev bremsstrahlung on enriched isotopes $Sn^{120}O_2$, $Sn^{122}O_2$, $Sn^{124}O_2$, and natural tin have resulted in the discovery of the new isotopes In^{121}, In^{123}, and their isomers. The previously reported activity of In^{119} is assigned to In^{119g}. The results are tabulated. Decay schemes and level assignments are proposed. All the decay characteristics fit into shell model systematics, allowing systematical studies on pertinent nuclear properties. Relative yields of photoreaction on tin are also derived on the basis of these decay schemes. (auth)

16280

ON THE DECAY OF ^{106}Rh. O. J. Segaert and J. Demuynck (Rijksuniversiteit, Ghent) and A. M. Hoogenboom and H. Van den Bold (Rijksuniversiteit, Utrecht). Nuclear Phys. 16, 138-52(1960) Apr. (In English)

The beta and gamma radiation following the 30 sec decay of Rh^{106} was investigated with a double-focusing beta-ray spectrometer and single-crystal, coincidence, and sum-coincidence gamma-ray spectrometers. Gamma rays of 0.513, 0.624, 0.87, 0.89, 1.045, 1.14, 1.31, 1.51, 1.55, 1.76, 1.93, 2.13, 2.30, 2.37, 2.44, 2.63, and 2.88 Mev were found in the decay of Pd^{106}. Relative intensities of beta and gamma rays are reported and a level scheme for Pd^{106} is proposed. Two new levels at 2.02, and 2.88 Mev are added. The intensity measurement of the K and L lines of the 0.513 Mev transition yields a K/LM ratio of 6.15 ± 0.62. (auth)

16281

SYMPLECTIC INVARIANCE AND THE PAIRING PROPERTY OF NUCLEAR INTERACTIONS. Igal Talmi (Weizmann Inst. of Science, Rehovoth, Israel). Nuclear Phys. 16, 153-7(1960) Apr. (In English)

The condition of symplectic invariance of a general two-body interaction in the j^n configuration is derived for all values of T without the explicit use of group theory. The relation of symplectic invariance to the pairing property is discussed. (auth)

16282

NITROGEN–ALUMINIUM ELASTIC SCATTERING. M. L. Halbert and A. Zucker (Oak Ridge National Lab., Tenn.). Nuclear Phys. 16, 158-67(1960) Apr. (In English)

The differential cross section for elastic scattering of 27.3-Mev nitrogen ions from aluminium was measured from 36° to 134° in the centre-of-mass system. A coincidence system detecting both the nitrogen and the aluminium ions was used to identify the elastic events. The angular resolution was about ±1 degree. The ratio of the elastic cross section to the Coulomb cross section exhibits a small rise above unity near 50° (c.m.), then drops almost exponentially from 60° to 134° (c.m.), where it has a value of 0.0265. The results of the experiment are compared with the predictions of a sharp cutoff calculation. Reasonably good agreement is obtained from 36° to 96° (c.m.) with an interaction radius $R = 9.07 \times 10^{-13}$ cm. If $R = \gamma_0(A_1^{1/3} + A_2^{1/3})$, the value of γ_0 is 1.68×10^{-13} cm. Beyond 96° (c.m.) the sharp cutoff calculation displays increasing oscillations and no longer fits the data. The results of a semi-classical scattering theory due to Ford and Wheeler are compared with the experimental data. The best fit is obtained for a rainbow angle $\theta_r = 94°$, corresponding to $\gamma_0 = 1.59 \times 10^{-13}$ cm, and a surface thickness parameter $\Delta R = 0.83 \times 10^{-13}$ cm. Quite good agreement between this theory and experiment is obtained from about 94° to 134° (c.m.). (auth)

16283

LOW-LYING ENERGY LEVELS OF Cs^{134}. I. V. Estulin, A. S. Melioranskii (Melioransky), and L. F. Kalinkin (Moscow State Univ.). Nuclear Phys. 16, 168-74(1960) Apr. (In English)

A study is made of the cascade γ-transitions following thermal neutron capture in cesium nuclei. Energy and quantum characteristics of low-lying excited states of Cs^{134} with excitation energy up to 320 kev are determined. (auth)

16284

DETERMINATION OF A 7×10^{-11} SEC HALFLIFE FOR THE FIRST EXCITED STATE IN THALLIUM 201. J. Lindskog, E. Bashandy, and T. R. Gerholm (Univ. of Uppsala). Nuclear Phys. 16, 175-87(1960) Apr. (In English)

A halflife $T_{1/2} = (7 \pm 2) \times 10^{-11}$ sec was found for the first excited 330-kev state in Tl^{201}. The measurements were performed in an electron-electron coincidence spectrometer by means of delayed coincidence technique. A new method to reduce the influence of energy dependent instrumental time-delays was developed. The $K/L_I + L_{II}$ and $L_I + L_{II}/L_{III}$ ratios for the 330 kev transition were measured by means of an iron yoke double focusing spectrometer. From these measurements the mixing ratio E2/M1 was found to be 2.2 ± 0.4. The transition matrix elements were calculated and are compared with the corresponding matrix elements in Tl^{203}. (auth)

16285

ABSORPTION CROSS SECTION OF GRAPHITE. P. F. Nichols (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 7, 395-9(1960) May.

A direct measurement of the graphite absorption cross section was made in the Physical Constants Testing Reactor (PCTR). The sample tested was reactor grade (GBF) graphite, and had a 2200 m/sec absorption cross section of 3.80 ± 0.04 mb including all impurities. This measurement also provides a normalization for the Hanford Test Reactor relative measurement which has been in progress for over fifteen years. Samples of American, French, and British graphite were also tested in the HTR to provide a basis for comparing the results of American, British, and French graphite absorption cross-section measurements. The graphite bars involved have also been tested at Harwell and Saclay. (auth)

16286

THE REACTIVITY OF NATURAL UO_2 IRRADIATED TO 6×10^{21} n/cm^2. S. B. Gunst, E. D. McGarry, and J. J. Scoville (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 7, 407-18(1960) May.

Natural uranium dioxide specimens of Shippingport PWR-1 blanket-rod geometry are exposed in the Materials Testing Reactor (flux 2×10^{14} n/cm^2-sec) and discharged periodically (every three weeks) for measurements in the Reactivity Measurement Facility (RMF). The time-integrated thermal and epithermal fluxes are measured during each exposure cycle, and together with the MTR Daily Power Logs, give the complete exposure history. Measurements in the RMF are used to determine an experimental value for η/η_0 (η_0 is the preirradiation value) which may be compared with the theoretical η/η_0 calculated for the measured exposure history using appropriate neutron-interaction parameters. In the theoretical calculations, the thermal absorption cross section of stable fission products is taken to be 50 barns per fission. Although the experimental and theoretical results are derived completely independently, agreement within 1% in η/η_0 is found for the behavior following all cycles of irradiation comprising exposures from zero to 15,600 Mwd/ton. (auth)

16287

FISSION-TO-INDIUM AGE IN WATER. D. B. Lombard and C. H. Blanchard (Pennsylvania State Univ., University Park). Nuclear Sci. and Eng. 7, 448-53(1960) May.

A redetermination of the age τ [$= \frac{1}{6}(r^2)$] for neutrons of indium-resonance energy (1.46 ev) from a point U^{235} fission source is reported. Foils were irradiated in a geometrically simple arrangement in the Penn State Reactor pool, and counted in a standard manner. The value obtained, $\tau = 27.3 \pm 0.9$ cm^2, is in better agreement with current theory than those from previous measurements. The spatial distribution found here differs most markedly from those observed in previous experiments by having a larger slope in the region within a few centimeters of the source. (auth)

16288

RESONANCE CAPTURE OF NEUTRONS IN NONHEAVY ABSORBERS. W. Rothenstein and J. Chernick (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 7, 454-7(1960) May.

In many instances resonance capture of neutrons can be calculated by one of two basic approximations. The narrow resonance approximation is valid if the practical width is small compared with the maximum energy loss of a neutron in an elastic collision. If the reverse is the case, the absorber atoms may be regarded as infinitely heavy. There are cases of wide, weakly absorbing, resonances however in which neither of these methods is reliable. Examples of these are given. An alternative method for calculating resonance capture for such resonances is presented and compared with Monte Carlo calculations of the capture fraction in bismuth-graphite lattices. (auth)

16289

ON THE TEMPERATURE DEPENDENCE OF THE THERMAL NEUTRON FLUX KERNEL. D. C. Anderson (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 7, 468-71(1960) May.

The thermal neutron flux kernel for a point fission source in a hydrogenous medium is obtained analytically by representing the epithermal slowing down source in a convenient functional form. Normalization is achieved by invoking an appropriate conservation condition. The temperature dependence is then assessed from experimentally determined variation in the diffusion length and appropriate variation in the fitting parameters for the slowing down source. It is concluded that the kernel for water is rather insensitive to change in the diffusion length, and in fact, the r^2-flux varies to a good approximation as $f(\rho r)$, ρ being the temperature-dependent specific gravity. (auth)

16290

A NOTE CONCERNING THE PURELY PROTON MODERATED SPECTRUM. B. J. Toppel (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 7, 476-7(1960) May.

Deviation of the hydrogen collision density from 1/E and the integral of the U^{235} fission spectrum as a function of energy are given. A comparison is made of the hydrogen-moderated spectrum and the U^{235} fission spectrum above 1 Mev. (W.L.H.)

16291

CALIBRATION OF LUTETIUM FOR MEASUREMENTS OF EFFECTIVE NEUTRON TEMPERATURES. L. C. Schmid and W. P. Stinson (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 7, 477-8(1960) May.

Experiments were conducted to determine the feasibility of using the ratio of activity of Lu^{177} to that of Lu^{176m} to measure effective neutron temperature. The experimental results include the half life of each activity, cadmium ratios for each isotope, and the ratio of the two activities for various neutron temperatures. The half lives were measured as 6.74 ± 0.04 days and 3.69 ± 0.04 hr for Lu^{177} and Lu^{176m}, respectively. (W.L.H.)

16292

OBSERVATIONS ON THE TYPE E2 γ RADIATION OF DEFORMED ATOMIC NUCLEI (NILSSON MODEL). D. Bogdan (Institut de Physique Atomique, Bucharest). Nuovo cimento (10) 15, 709-18(1960) Mar. 1. (In French)

The probability of E2-type gamma transitions was calculated using the Nilsson representation which takes into account the coupling between different states. The results of calculations of the electric quadrupole moments were used. The study of E2-type γ transitions of odd nuclei in the region $150 < A < 188$ shows that it is necessary to make use of the Nilsson representation. (tr-auth)

16293

MUON CAPTURE IN ^{12}C. M. Morita (Columbia Univ., New York) and A. Fujii (Purdue Univ., Lafayette, Ind.). Nuovo cimento (10) 15, 850-2(1960) Mar. 1. (In English)

Improved results are reported for the Fujii-Primakoff calculations of the partial transition rate of the muon capture reaction $\mu^- + C^{12} \rightarrow B^{12} + \nu$. The results are presented in graphical and tabular form. For the most accepted value of the ratio of pseudoscalar strength and axial vector coupling constant, $C_P/C_A \sim 8$, the prediction is about 10% below that of Fujii-Primakoff. (B.O.G.)

16294

β-γ DIRECTIONAL CORRELATION IN Eu^{152}. S. K. Bhattacherjee and S. K. Mitra (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 16, 175-89(1960) Apr. 1. (In English)

The directional correlation between the first forbidden 1483 kev β-group and the 344 kev E2 γ-transition in the decay of 13-year Eu^{152} was measured as a function of β-energy above 950 kev. The integral β-γ correlation data for β energies above 950 kev can be fitted with a directional correlation function $W(\theta) = 1 - (0.379 \pm 0.004) \cos^2 \theta$. The anisotropy is negative and is found to increase with β-energy, its value is −0.416 ± 0.012 at 1350 kev, the maximum energy at which measurements were made. The energy dependence of the anisotropy excludes the unique character of the β-transition. The observed energy dependence of the anisotropy is fitted with the V − A theory in the modified B_{ij} approximation yielding two values of the matrix element ratio $Y = (C_V/C_A)(\int i\alpha/\int B_{ij}) \approx$ 1.05 or 0.09. The former value of Y, however, reproduces closely the spectral shape recently observed for the 1483 kev β-group. (auth)

16295

THE EXCITED STATES OF GADOLINIUM-155. Jose O. Juliano (Philippine Atomic Energy Commission, Manila). Philippine J. Sci. 88, 81-93(1959) Mar.

The internal conversion electron lines of Eu^{155} were studied with four electron spectrographs whose different magnetic field intensities enabled them to cover the energy range from a few kev to 3 Mev, and whose resolution was ~0.1%. The transitions assigned to Gd^{155} are 18.8, 41.6, 59.9, 85.9, 86.5, and 105.2 kev; the 145-kev transition reported from the Coulomb excitation of Gd^{155} was not observed. Each of the assignments is discussed in detail and multipolarity assignments are also given. A decay scheme is proposed for Eu^{155} showing the excited states of Gd^{155}. From this scheme the abundances of the beta components of Eu^{155} were calculated and found to agree well with the experimental results. (D.L.C.)

16296

MAGNETIC HYPERFINE STRUCTURE OF THE GROUND STATE OF LITHIUM. R. K. Nesbet (Massachusetts Inst. of Tech., Lexington). Phys. Rev. 118, 681-3(1960) May 1.

The magnetic hyperfine splitting of the ^2S ground state of the lithium atom is calculated. It is shown that the discrepancy between experiment and the value calculated in the traditional Hartree-Fock approximation can be accounted for quantitatively by the exchange polarization effect, which distorts one 1s orbital relative to the other. The present calculation obtains a value within one percent of the experimental value. A general procedure is proposed for evaluating operators that do not commute with the Hamiltonian, when approximate variational methods must be used. (auth)

16297

TOTAL NEUTRON CROSS SECTIONS OF HELIUM, NEON, ARGON, KRYPTON, AND XENON. F. J. Vaughn, W. L. Imhof, R. G. Johnson, and M. Walt (Lockheed Missiles and Space Research Lab., Palo Alto, Calif.). Phys. Rev. 118, 683-6(1960) May 1.

The total neutron cross sections of the noble gases helium, neon, argon, krypton, and xenon were measured for neutron energies from 120 kev to 6.2 Mev and from 12.1 Mev to 19.8 Mev by a transmission experiment. The neutrons were produced using the $Li^7(p,n)Be^7$, the $T(p,n)He^3$, the $D(d,n)He^3$, and the $T(d,n)He^4$ reactions in the appropriate energy intervals. A Van de Graaff accelerator was the source of the protons or deuterons. In general, the results obtained agree with previous work where such work exists. A previously unobserved S-wave scattering resonance was found in neon at about 500 kev, indicating the presence of an excited state in Ne^{21} with $J = \frac{1}{2}$ and even parity. The results for argon, krypton, and xenon exhibit general agreement with the cross sections of neighboring elements, as would be expected from the previously observed smooth variation of the $\sigma(A,E)$ surface. (auth)

16298

SLOW NEUTRON RESONANCE SPECTROSCOPY. I. U^{238}. J. L. Rosen, J. S. Desjardins, J. Rainwater, and W. W. Havens, Jr. (Columbia Univ., New York). Phys. Rev. 118, 687-97(1960) May 1.

The results of time-of-flight measurements of U^{238} resonances in the region 90 to 1300 ev are presented and resonance parameters for levels up to 1000 ev are obtained. Neutron widths for the 55 observed levels and radiation widths for 32 of the stronger levels are deduced. The deduced neutron width distribution is found to be in good agreement with the theoretical prediction of Porter and Thomas for a single channel process, while the level spacing distribution agrees with the "repulsion" formula suggested by Wigner. The average value of the radiation widths was found to be $(24.6 \pm 0.8) \times 10^{-3}$ ev, while the average reduced neutron width and level spacing were found to be $(1.76 \pm 0.26) \times 10^{-3}$ ev and 18.5 ± 1.3 ev, respectively. These values are in good agreement with earlier results reported by other workers. A strength function of $(0.95 \pm 0.15) \times 10^{-4}$ is obtained. It appears on the basis of their size and number, that several of the weaker levels may be due to p-wave neutrons. (auth)

16299

HALF-LIFE OF Pb^{210}. W. R. Eckelmann, W. S. Broecker, and J. L. Kulp (Columbia Univ. Lamont Geological Observatory, Palisades, N. Y.). Phys. Rev. 118, 698-701 (1960) May 1.

A new determination of the half-life of Pb^{210} was made by the geological method. $PbCl_2$ extracted from uranium minerals in secular equilibrium was used to calibrate a thick-source scintillation counter for Po^{210} alpha particles. Using this calibration the absolute activity of Po^{210} in partial equilibrium with a known number of Pb^{210} atoms prepared from the decay of a measured quantity of radon was determined. From these data a half life of 21.4 ± 0.5 years was obtained for Pb^{210}. (auth)

16300

ENERGY LEVEL PARAMETERS FROM NUCLEAR RESONANCE FLUORESCENCE AT 7 MEV. K. Reibel and A. K. Mann (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 118, 701-13(1960) May 1.

The recoil-broadened photon spectrum from the reaction $F^{19}(p,\alpha\gamma)O^{16}$ was used to measure the elastic photon scattering cross sections of 31 elements at 7 Mev. The observed angular distributions are consistent with dipole transitions. A plot of the cross sections versus mass number shows definite peaks around the closed shell regions near Z = 50, N = 82 (Sn, Te, and Ba), and Z = 82, N = 126 (Pb and Bi). For six medium and heavy elements self-absorption measurements were made which, when analyzed in terms of a number of nonoverlapping Breit-Wigner resonances, yield values of the average partial radiation widths to the ground states, the average total radiation widths, and the average level spacings for those elements. The radiation widths are significantly larger than those determined from slow-neutron scattering and capture experiments and, excepting Pb and Bi, the average level spacings are also appreciably greater than would be expected from the neutron data. The observed widths and spacings are in order of magnitude agreement with the recent interpretation of the modified single-particle calculation of Blatt and Weisskopf. (auth)

16301

SLOW NEUTRON TOTAL AND FISSION CROSS SECTIONS OF U^{233}. M. S. Moore, L. G. Miller, and O. D. Simpson (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev. 118, 714-17(1960) May 1.

The slow neutron total and fission cross sections of U^{233} were measured from 0.02 ev to 200 ev on the MTR (Materials Testing Reactor) fast chopper. The strong resonances are resolved below a neutron energy of 15 ev, and show marked interference effects in the fission cross section. No resonances are observed in the total cross section which are not also present in the fission cross section, except for those attributed to the known contaminants in the samples. An estimate of the neutron strength function (Γ_n^0/D), made by an area analysis, gives the value $(1.0 \pm 0.2) \times 10^{-4}$ for this energy region in U^{233}. (auth)

16302

MULTILEVEL ANALYSIS OF THE SLOW NEUTRON CROSS SECTIONS OF U^{233}. M. S. Moore and C. W. Reich (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev. 118, 718-24(1960) May 1.

A multilevel analysis of the slow neutron total and fission cross sections of U^{233} from thermal energies to 11 ev was carried out, under the assumption that in one of the two spin states the nucleus undergoes fission primarily through a small number of channels. The cases of one and of two fission channels for this spin state were investigated in detail. Although the analysis does not yield an exact value for the number of available fission channels, the data are adequately fit with a two fission channel formula. It is not necessary to invoke any negative energy resonances in the analysis. The presence of a noninterfering component in the cross sections, having a 1/v energy variation, is indicated. At thermal energies, this component accounts for approximately 80% of the total and fission cross sections. An interpretation of this component as being due to one spin state of the compound nucleus is presented. Under this assumption, the fission characteristics of the two spin states of the compound nucleus formed by s-wave neutrons are quite different. (auth)

16303

LOW-ENERGY NEUTRON CROSS SECTIONS OF FISSIONABLE NUCLEI. Erich Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. 118, 724-33(1960) May 1.

The method of analysis developed in a previous paper is applied to the low-energy neutron cross sections of the common fissionable isotopes. Further evidence is presented to show that U^{235} possesses the unusual negative energy level required by the previous analysis. However, good fits are obtained for the cross sections of both U^{233}

and Pu^{239} without such an unusual bound level, suggesting that the neutron resonance cross sections of the fissionable isotopes do not exhibit a basic anomaly. The size of the level interference effects in each of the isotopes implies that the fission process involves more than one but no more than a few fission channels. (auth)

16304

SHELL MODEL ASSIGNMENTS FOR THE ENERGY LEVELS OF C^{14} AND N^{14}. E. K. Warburton and W. T. Pinkston (Princeton Univ., N. J.). Phys. Rev. 118, 733-54 (1960) May 1.

Electromagnetic transition widths, reduced widths, and inelastic scattering cross sections are calculated for the following states of N^{14} and C^{14}: (1) The levels arising from the ground-state configuration, s^4p^{10}, (2) the odd-parity levels arising from excitation of a 1p nucleon into the degenerate $2s_{\frac{1}{2}}$ and $1d_{\frac{3}{2}}$ shells, (3) the even-parity group of levels formed by excitation of two 1p nucleons into the 2s and 1d shells. The calculations for the s^4p^{10} configuration are carried out using the wave functions of Elliott and of Visscher and Ferrell, and in jj coupling. The calculations for the odd-parity levels are done in the jj-coupling scheme. For the even-parity excited configuration an inert C^{12} core is assumed and M1 radiative widths are calculated for states arising from $s^2 + d^2 + sd$. The calculations are compared to the existing data. On the basis of this comparison shell-model assignments are proposed for 19 of the 27 known levels below 11-Mev excitation in N^{14} and for all the known levels in C^{14} below 9-Mev excitation. (auth)

16305

GAMMA-RAY INTENSITIES IN THE THORIUM ACTIVE DEPOSIT. Guy T. Emery and Walter R. Kane (Harvard Univ., Cambridge, Mass.). Phys. Rev. 118, 755-62(1960) May 1.

The relative intensities of the gamma rays of the descendants of radiothorium were studied by measuring the photoelectron spectra from thorium and platinum foils. The relative sensitivity of the arrangement at different energies was found by using other sources having gamma rays of known relative intensity. Comparison of the measured gamma-ray intensities with the measurements by others of internal conversion intensities allows internal conversion coefficients to be computed and the multipolarities of several transitions to be determined. An electric monopole transition was found in Po^{212}. The gamma-ray intensities are used to find the intensities of beta-ray branches. Gamma-ray intensities are compared with the known intensities of long-range alpha particles from Po^{212} and transition probabilities are estimated for some electromagnetic transitions between states of that nucleus. The level schemes of Po^{212} and Pb^{208} are discussed in the light of the information found here and of other recent information. (auth)

16306

FISSION OF Ra^{226} BY DEUTERONS AND HELIUM IONS. R. C. Jensen and A. W. Fairhall (Univ. of Washington, Seattle). Phys. Rev. 118, 771-5(1960) May 1.

Fission induced in Ra^{226} by 14.5- and 21.5-Mev deuterons, and by 23.5-, 31-, and 43-Mev He ions was studied using radiochemical techniques. The mass distributions of fission products for deuteron-induced fission is triple-humped, corresponding to separate symmetric and asymmetric fission modes. The symmetric mode dominates at the higher bombarding energy. The mass distributions observed for fission products from He-ion induced fission look more "normal": asymmetric at the lowest bombarding energy, becoming a single broad peak at the highest bombarding energy. These results are interpreted in terms of a symmetric fission mode which increases strongly with increasing excitation energy, and an asymmetric fission mode which occurs mainly at low excitation energies following neutron evaporation from highly excited compound nuclei. Asymmetric fission is interpreted to be disappearing as a fission mode for nuclei of lower atomic number than thorium. (auth)

16307

DECAY OF Sm^{155}. R. E. Sund, R. G. Arns, and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). Phys. Rev. 118, 776-80(1960) May 1.

Sm^{155} was found to decay to Eu^{155} with a half life of 21.9 ± 0.2 minutes. Internal conversion electrons corresponding to the gamma rays in Eu^{155} were observed in a magnetic spectrometer. The gamma ray spectrum was studied with a well crystal. The spectra of gamma rays coincident with the x ray, 104-kev, 142-kev, and 246-kev gamma rays were observed. A number of new, weak transitions are proposed. Directional correlation measurements were made on the 142-kev–104-kev cascade. Possible spin assignments are discussed. (auth)

16308

MONTE CARLO CALCULATIONS OF NUCLEAR EVAPORATION PROCESSES. IV. SPECTRA OF NEUTRONS AND CHARGED PARTICLES FROM NUCLEAR REACTIONS. Israel Dostrovsky and Zeev Fraenkel (Weizmann Inst. of Science, Rehovoth, Israel); and Lester Winsberg (Univ. of California, Berkeley; and Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. 118, 781-91(1960) May 1.

The calculation of spectra of neutrons and charged particles and of cross sections for their production from nuclear reactions is compared with experimental values. A compound-nucleus mechanism followed by nuclear evaporation is assumed for the reactions Zr, Ta, Bi(14.1-Mev n,n′); Ni(13.4 – 17.5-Mev n,p); Cu, Pd(23-Mev p,α); and Ni(162-Mev O^{16},α). The production of neutrons and charged particles from the interaction of 190-Mev protons with Ni, Ag, and Au is analyzed in terms of a nucleon cascade, followed by particle evaporation. The calculation of the nuclear evaporation is based on Weisskopf's statistical theory. Fairly good agreement is obtained for the values of the cross sections for producing these particles with an appropriate set of radius and level-density parameters in each case. There are serious discrepancies, however, in the comparison of the experimental and calculated spectra; many of the latter are deficient in low-energy neutrons and charged particles. Possible improvements in the calculation are discussed. (auth)

16309

MONTE CARLO CALCULATIONS OF NUCLEAR EVAPORATION PROCESSES. V. EMISSION OF PARTICLES HEAVIER THAN He^4. I. Dostrovsky, Z. Fraenkel, and P. Rabinowitz (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. 118, 791-3(1960) May 1.

Previous Monte Carlo calculations of nuclear evaporation reactions were extended to include the emission of He^6, Li^6, Li^7, Li^8, and Be^7 from Cu, Ag, Au, and Bi targets bombarded with high-energy protons (340 to 2000 Mev). Comparison with available experimental results shows good agreement in most cases. A discrepancy was observed between the calculated and observed variation of Be^7 formation cross section with the mass of the target nucleus, but even here the agreement is within a factor of three. It is shown that, for the usually chosen parameters of the calcu-

lation, a level density parameter of a = A/10 is necessary. (auth)

16310

DIRECT DETERMINATION OF INTERNAL CONVERSION COEFFICIENTS. Paresh Mukherjee (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev. 118, 794-6(1960) May 1.

Using the same source and instrument geometry, both the external as well as internal conversion lines of the 1.17- and 1.33-Mev gamma rays of Co^{60} are scanned in a Siegbahn-Slätis spectrometer. From the known internal conversion coefficients of these gamma rays, the instrument is calibrated for the direct determination of internal conversion coefficient of any other gamma rays having energy near 1.3 Mev. As an example, the internal conversion coefficient of the 1.408-Mev gamma ray, in the decay of Eu^{152}, is measured. The value obtained is 4.99×10^{-4}. (auth)

16311

SLOW NEUTRON SCATTERING BY THE TITANIUM ISOTOPES. C. G. Shull and M. K. Wilkinson (Oak Ridge National Lab., Tenn.) and M. H. Mueller (Argonne National Lab., Lemont, Ill.). Phys. Rev. 118, 797-8(1960) May 1.

Neutron diffraction studies are reported on isotopically enriched samples of TiO_2 from which are evaluated the coherent scattering amplitudes of the titanium isotopes. Scattering amplitudes of +0.48, +0.33, −0.58, +0.08, and $+0.55 \times 10^{-12}$ cm were established for the titanium isotopes of mass 46, 47, 48, 49, and 50, respectively. The major isotope Ti^{48} is thus responsible for the anomalous scattering amplitude, -0.34×10^{-12} cm, characteristic of the normal element. Pronounced nuclear scattering resonance effects on the observed neutron scattering are suggested to occur for most of the isotopes. (auth)

16312

PRECISION MEASUREMENT OF THE TOTAL NEUTRON CROSS SECTION OF U^{233} BETWEEN 0.000818 AND 0.0818 ev. G. J. Safford, W. W. Havens, Jr., and B. M. Rustad (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 118, 799-802(1960) May 1.

The absolute value of the total neutron cross section of U^{233} was measured at neutron energies between 0.000818 ev and 0.0818 ev for two types of samples, a metallic foil and D_2O solutions of uranium nitrate. Balanced solutions of $U^{235}O_2(NO_3)_2$ and $U^{238}O_2(NO_3)_2$ were used to determine the difference between the total cross sections of U^{233} and U^{238}. This value when combined with the relatively small known value of the total cross section for U^{238} gives $\sigma_T(U^{233}) = 587 \pm 5$ barns at 0.0253 ev. The measurements on the metallic U^{233} foil agreed with the measured total cross section determined from the liquid solution data to better than 1%, yielding $\sigma_T(U^{233}) = 586 \pm 2$ barns at 0.0253 ev. (auth)

16313

POLARIZATION OF 9-MEV PROTONS ELASTICALLY SCATTERED FROM MAGNESIUM. A. B. Robbins (Univ. of Birmingham, Eng. and Rutgers Univ., New Brunswick. N. J.) and G. W. Greenlees (Univ. of Birmingham, Eng.). Phys. Rev. 118, 803-7(1960) May 1.

The polarization as a function of angle was measured for protons elastically scattered from a 1-Mev thick magnesium target with a mean energy of 9.1 Mev. The resulting polarization distribution is compared to a differential cross-section measurement with the same target. (auth)

16314

ELASTIC SCATTERING OF 5.6-MEV NEUTRONS FROM CARBON. J. E. Braley and C. W. Cook (Convair, San Diego, Calif.). Phys. Rev. 118, 808-11(1960) May 1.

Energetic neutrons produced from the $D(d,n)He^3$ reaction were scattered from a cylindrical carbon sample to study the angular distribution of elastically-scattered, 5.6-Mev neutrons. The differential elastic scattering cross sections for carbon were obtained for angles in the range of 30 to 150 degrees. A thin plastic neutron-proton recoil detector was used in the measurements to permit discrimination against 4.4-Mev gamma rays from the carbon sample, and other gamma-ray backgrounds. (auth)

16315

MOMENTS OF INERTIA OF EVEN-EVEN RARE EARTH NUCLEI. J. J. Griffin and M. Rich (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 118, 850-4(1960) May 1.

Moments of inertia of even-even nuclei are computed using the Nilsson model for deformed nuclei and the moment formula derived from the superconductor theory of nuclei. Values for the energy gap and the deformation are obtained from appropriate experimental data. Good agreement is found between the computed and observed energies of the first excited states of twenty-six rare earth nuclei. This success lends strong support to the superconductor theory of the nucleus. (auth)

16316

DIRECTIONAL CORRELATION OF THE GAMMA RAYS IN W^{182}. G. D. Hickman and M. L. Wiedenbeck (Univ. of Michigan, Ann Arbor). Phys. Rev. 118, 1049-53(1960) May 15.

Directional correlation measurements were performed on seven cascades involving the gamma rays in W^{182}. The angular momenta of the excited states and the character of the gamma transitions which were determined by the correlation measurements are in good agreement with the values as determined by previous investigators. There is evidence for the existence of three rotational bands with the possibility of a fourth band in W^{182}. The nature of these rotational bands is explained in terms of the Bohr-Mottelson model for spheroidal nuclei. The levels are characterized by the quantum numbers (K. I, π). After correction for x-ray interference the 1.222 Mev−0.068-Mev correlation results in a spin of 3 to the 1.290-Mev level. The 0.068-Mev gamma ray is essentially pure dipole radiation. The results of the 1.231 Mev−0.100-Mev correlation are in good agreement with spin 3 to the 1.331-Mev level with a quadrupole content of $2 \pm 0.5\%$ for the 1.231-Mev radiation. The 0.152 Mev-1.222-Mev correlation is only in agreement with an assignment of spin 3 to the 1.374-Mev level with a quadrupole content of less than 0.5% for the 0.152-Mev transition. The 0.152 Mev-1.122-Mev correlation yields a quadrupole content of (3-11% or 94−99%) for the 1.122-Mev transition. The 0.222 Mev-1.231 Mev, 0.264 Mev-1.222-Mev correlations are in good agreement with the assignment of spin 4 to the 1.554-Mev level. However, spins of 3 or 5 for the 1.554-Mev level are also in agreement with the correlation data. (auth)

16317

NONELASTIC SCATTERING OF FAST NEUTRONS. J. T. Prud'homme, P. L. Okhuysen, and I. L. Morgan (Texas Nuclear Corp., Austin, Tex.). Phys. Rev. 118, 1059-62 (1960) May 15.

The relative angular distributions of neutrons inelastically scattered from iron, yttrium. zirconium, radiogenic lead (88% Pb^{206}), lead, and bismuth were measured for neutrons in the region from 3.7 to 4.7 Mev. The relative angular distributions of the low energy (0.5 to 4 Mev) neutrons resulting from nonelastic scattering of 15.2-Mev neutrons were also measured. In each case the distributions were found to be isotropic within experimental error

(±15%), therefore supporting earlier evidence of compound nucleus formation as the predominant interaction mechanism. (auth)

16318

SURVEY OF (p,d) REACTIONS AT 22 Mev. C. D. Goodman and J. B. Ball (Oak Ridge National Lab., Tenn.). Phys. Rev. 118, 1062-6(1960) May 15.

Energy spectra of deuterons from (p,d) reactions on medium and heavy weight elements were surveyed. The experimental method of particle identification is described. The spectra show gross structure indicative of strong selection rules. The gross structure can be correlated with nuclear shell structure, and the levels which are most strongly excited are those which have the same shell configurations as the target with one neutron missing. Angular distributions confirm the shell assignments. This leads to a picture of the reaction mechanism for (p,d) reactions in which the incoming proton interacts principally with a single neutron rather than with the nucleus as a whole. (auth)

16319

RADIOACTIVE DECAY OF Lu^{172}. R. G. Wilson and M. L. Pool (Ohio State Univ., Columbus). Phys. Rev. 118, 1067-72(1960) May 15.

Ytterbium oxide enriched to 95.9% in mass number 172 was irradiated with 6-Mev protons. An activity decaying by electron capture with a half-life of (6.70 ± 0.04) days was produced and its assignment to Lu^{172} confirmed by the identification of the ytterbium K x ray and by comparison with the activities produced by similar proton irradiations of the other enriched isotopes of ytterbium. The 4.0-hour positron activity previously assigned to Lu^{172} was not observed and is best attributed to an impurity. The observed activity of Lu^{172} consists of the L and K x rays of ytterbium and gamma rays with energies of 79, 91, 113, 182, 203, 270, 324, 373, 490, 527, 697, 809, 900, 912, 1093, 1402, and 1583 kev. Because no positron radiation exists in the activity of Lu^{172}, the mode of decay is solely by electron capture to Yb^{172}. Gamma-gamma coincidence measurements, energy considerations, and consideration of the relative numbers of the radiations observed in the activity of Lu^{172} have led to the assignment of energy levels at 530 (6+), 1172 (3+), 1263 (4+), 1375 (5+), 1662 (3−), (1699), and 2072 (4+) kev in Yb^{172} in addition to the previously known 78.7 (2+)- and 260.2 (4+)-kev levels. The positions of all of the observed radiations and some observed only in conversion electron measurements are shown in a proposed energy level scheme for the decay of Lu^{172}. Approximate branching ratios for the electron capture disintegrations of Lu^{172} are also shown in the level scheme. Few, if any, electron capture transitions of Lu^{172} occur to the ground and first excited states of Yb^{172}. Of the two predicted spins for the ground state of Lu^{172}, 4− is more consistent with the proposed energy level scheme. (auth)

16320

DECAY OF THE $i_{13/2}$ STATE IN Pb^{205}. R. Stockendal (Nobel Inst. of Physics, Stockholm). Phys. Rev. 118, 1074-6(1960) May 15.

The L_I, L_{II}, L_{III}, M_I, M_{II}, M_{III}, M_{IV}, N_I, N_{III}, and O_I conversion lines of a 26.22 ± 0.01-kev transition in Pb^{205} were found from studies with electromagnetically separated samples of Bi^{205}. The transition, having M2 character, most probably takes place from a 4-msec $i_{13/2}$ state of 1014.0 kev to the 987.6-kev 9/2-state, thus causing the latter state to appear metastable, as has been reported earlier. This suggestion is also supported by strong evidence for the existence of a 310.5-kev E3 transition between the isomeric state and the 703.3-kev state. The energy 1014.0 kev of the $i_{13/2}$ state coincides with a transition energy in Pb^{205} earlier reported, and is found to fit well into the energy systematics of the $i_{13/2} \rightarrow f_{5/2}$ M4 transitions in the odd lead isotopes. (auth)

16321

ISOMERIC TRANSITION IN Pb^{205}. David E. Alburger (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 118, 1076-80(1960) May 15.

A (26 ± 1)-kev transition in Pb^{205} occurring in the electron capture decay of Bi^{205} was identified from its L, M, and N internal conversion electrons measured in an intermediate-image beta-ray spectrometer. By using NaI scintillation detectors behind the source in the spectrometer the M and N lines of the 26-kev transition are found to be not in coincidence with electron-capture K x rays but they are in coincidence with a principal gamma ray of 1 Mev and weak components of ~0.7 and ~0.3 Mev. Since the Bi^{205} gamma rays of 987.8 and 284.2 kev and a fraction of the 703.3-kev gamma rays have been shown by Vegors and Heath to be delayed with respect to electron-capture K x rays with a half-life of 4.8 msec, the present coincidence results indicate that the delayed radiation is associated with the 26-kev transition originating from an isomeric state in Pb^{205} at 1013.8 kev. The 26-kev transition is probably a quadrupole and a possible assignment is M2 if the spin-parity assignment of the 987.8-kev level is 9/2− and if the 1013.8-kev level is the 13/2+ state predicted at 1.1 Mev by Pryce. The possibility that all or part of the known 1014.2-kev gamma radiation constitutes the "missing" M4 transition in Pb^{205} is discussed. (auth)

16322

DECAY OF 45-DAY Fe^{59}. R. L. Heath, C. W. Reich, and D. G. Proctor (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev. 118, 1082-6(1960) May 15.

The gamma rays following the decay of 45-day Fe^{59} were studied using the techniques of gamma-ray scintillation spectrometry, including γ-γ coincidence and γ-γ directional correlation measurements. In addition to the previously reported 0.192-, 1.10-, and 1.29-Mev gamma rays, two additional gamma rays having energies of 0.145 and 0.337 Mev were observed. These latter two arise from a state at 1.43 Mev in Co^{59}. All gamma rays were observed to decay with a half-life of 45 ± 5 days. Directional correlation measurements on the 0.14 − 1.29 Mev and 0.19 − 1.10 Mev cascades were performed. The results of these measurements, together with the gamma-ray relative intensities, suggest an assignment of $\frac{1}{2}-$ to the 1.43-Mev state in Co^{59}. (auth)

16323

ATTEMPTS TO DETECT RESONANCE SCATTERING IN Zn^{67}; THE EFFECT OF ZERO-POINT VIBRATIONS. R. V. Pound and G. A. Rebka, Jr. (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters 4, 397-9(1960) Apr. 15.

Unsuccessful attempts to detect the Mössbauer effect in the 93-kev gamma ray from the 9.4-μsec level of Zn^{67} are described. The conditions were: (1) source vibration with a rms velocity of ~10^{-3} cm/sec; (2) sources of Ga^{67} dissolved in Al−Zn alloy (95−5 wt.%), in polycrystalline zinc, in a single zinc crystal, and in an irradiated copper foil; and (3) absorbers of Al−Zn alloy (90−10 wt.%), polycrystalline zinc, single zinc crystals, and natural sphalerite (ZnS). No resonant absorption greater than 0.3% under any of the above conditions was found. A possible reason for this failure is a difference between the Debye temperatures of the source and absorber leading to differences in the frequency. Therefore, the only source-absorber combina-

tion expected to show resonant absorption would be that using zinc directly, and the effect then was probably too small to be detected. (D.L.C.)

16324

SEARCH FOR THE ANISOTROPY OF INERTIA USING THE MÖSSBAUER EFFECT IN Fe^{57}. C. W. Sherwin, H. Frauenfelder, E. L. Garwin, E. Lüscher, S. Margulies, and R. N. Peacock (Univ. of Illinois, Urbana). Phys. Rev. Letters 4, 399-401(1960) Apr. 15.

The width of the central resonance absorption line in the Mössbauer effect in Fe^{57} being wider than the natural linewidth suggests that an external perturbation exists which affects the nuclear levels. Accordingly, experiments were carried out to detect whether anisotropy in inertia (due to nonuniform distribution of matter in the galaxy) may be responsible for the line broadening. The linewidth was measured for a Fe^{57} source and a Fe absorber with (1) no magnetic field present and (2) both source and absorber parallel to magnetic fields of about 10^3 gauss; no difference was found. Next, the amplitudes of the center of the line and of four Doppler-shifted points on the side of the line were measured with 600-gauss magnetic fields oriented at +45° and −45° in the vertical (north-south) plane at different times so that the galactic center exerts its maximum and minimum effects on the level shift. The amplitudes were found to be constant within the statistical limits, which give a result of $\Delta M/M$ (fraction of inertia change) of $< 5 \times 10^{-16}$. (D.L.C.)

16325

MEASUREMENT OF LOCAL FIELDS AT IMPURITY Fe^{57} ATOMS USING THE MÖSSBAUER EFFECT. G. K. Wertheim (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters 4, 403-5(1960) Apr. 15.

The Mössbauer effect in Fe^{57} was used to study the local fields in Fe, Co, Ni, and n-type Si. Sources were prepared by coating the metal (Fe, Co, Ni, or Si) with Co^{57} as such or as $CoCl_2$, and the absorber was either type 310 stainless steel (Cr−Ni, 25−20%) or potassium ferrocyanide. Data gave a magnetic field for Fe^{57} of 3.3×10^5, 3.1×10^5, 2.6×10^5, and 3×10^4 gauss in Fe, Co, Ni, and n-type Si, respectively. Line broadening was observed for the stainless steel absorber experiments over those in which both source and absorber were iron, and possible reasons for this broadening are given. The advantages of silicon as a source base for Fe^{57} over the others due to the absence of self-absorption are pointed out. (D.L.C.)

16326

RECOILLESS RAYLEIGH SCATTERING IN SOLIDS. C. Tzara and R. Barloutaud (Centre d'Études Nucléaires, Saclay, France). Phys. Rev. Letters 4, 405-6(1960) Apr. 15.

A photon analyzer made extremely selective in energy using the Mössbauer effect is used in the analysis of recoilless Rayleigh scattering of x rays by platinum, aluminum, graphite, and paraffin solids. The source is Sn^{119} which, upon being excited, emits 23.8-kev photons; the photons are scattered by the solids at 50 ± 5° and absorbed by a Sn^{119} foil. The change in counting rates between the temperatures of 80 and 300°K was measured. Agreement between the theoretical and observed reductions in x-ray intensity at 80°K is good. (D.L.C.)

16327

EVIDENCE FOR QUADRUPOLE INTERACTION OF Fe^{57m}, AND INFLUENCE OF CHEMICAL BINDING ON NUCLEAR GAMMA-RAY ENERGY. O. C. Kistner and A. W. Sunyar (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 4, 412-15(1960) Apr. 15.

The recoil-free emission and resonant absorption (Mössbauer effect) of the 14.4-kev gamma ray of Fe^{57} were used to determine the quadrupole coupling for the 3/2-excited state of Fe^{57} bound in Fe_2O_3, and to measure the energy shift of the gamma ray. The internal magnetic field at the Fe^{57} nucleus bound in Fe_2O_3 was also measured. The source was Co^{57} plated onto stainless steel (Cr 25%, Ni 20%), and the absorber was Fe_2O_3 enriched ~30% in Fe^{57}; both were kept at 25°C during experiments. The results give an indication of a small quadrupole moment for Fe^{57m} and an energy shift of $2.26 \pm 0.15 \times 10^{-8}$ ev between stainless steel and Fe_2O_3. An internal magnetic field of 5.15×10^5 gauss is calculated for Fe^{57} in Fe_2O_3. Differences in the chemical environment which could have caused the energy shift are discussed. The importance of having both the source and absorber identical chemically for Mössbauer effect studies is stressed. (D.L.C.)

16328

RESONANCES IN C^{12} ON CARBON REACTIONS. E. Almqvist, D. A. Bromley, and J. A. Kuehner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Letters 4, 515-17(1960) May 15.

The reaction yield from C^{12} on carbon targets was studied for the laboratory energy range 9 to 29 Mev. Excitation curves are included for protons at 27°, alpha particles at 42°, neutrons at 30°, and gamma radiation at 90°. The magnitudes of the corresponding differential cross sections at 10 Mev (center-of-mass system) incident energy are: protons, 15 mb/sr; alpha particles, 34 mb/sr; and neutrons, 3 mb/sr. These cross sections refer to protons > 6 Mev, alpha particles > 7.5 Mev, and all neutrons. Excitation curves are given for O^{16} on oxygen reactions. Alpha particles were detected at 27° and gamma radiation at 90°. The alpha production cross section at 10 Mev incident energy was 4.5 mb/sr. The classical Coulomb barrier was indicated at 6.6 and 10.5 Mev for C^{12} and O^{16} reactions, respectively. (B.O.G.)

16329

"MOLECULAR" STATES FORMED BY TWO CARBON NUCLEI. Erich Vogt and Hugh McManus (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Letters 4, 518-20(1960) May 15.

The existence of "molecular" states of two C^{12} nuclei is discussed, based on its physical origin and its implications for nuclear structure. The experimental data are the cross sections for carbon and oxygen bombardment by C^{12} and O^{16} ions at energies to 15 Mev. The width and spacing of the observed $C^{12} + C^{12}$ resonance levels cannot be attributed to the compound nucleus Mg^{24}. The spacing is that of a well much larger than the usual Mg^{24} nucleus. The observed resonances are attributed to almost pure single-particle states of two C^{12} nuclei. A qualitative illustration is given of the potentials connected with the motion of two C^{12} nuclei as a function of their separation. (B.O.G.)

16330

GRAZING COLLISIONS OF COMPLEX NUCLEI. R. H. Davis (Florida State Univ., Tallahassee). Phys. Rev. Letters 4, 521-2(1960) May 15.

A simple liquid-drop model was used to investigate the nuclear interactions between complex nuclei. Interpretations of earlier work suggest that elastic scattering of complex nuclei is restricted to grazing collisions due to the highly absorbent nuclear interior. Interaction potentials between carbon nuclei are given as a function of the separation for various values of orbital angular momentum quantum numbers. Levels for C on C and O on O are shown

with rotation-vibration interaction, the vibrational quantum number, and the center-of-mass excitation energy. The elastic scattering of C on C and O on O is illustrated with cross sections as a function of center-of-mass energies. (B.O.G.)

16331

DECAY OF Eu^{152}. P. N. Mukherjee, I. Dutt, A. K. Sen Gupta, and R. L. Bhattacharyya (Saha Inst. of Nuclear Physics, Calcutta). Physica 26, 179-90(1960) Mar. (In English)

The decay of mass-spectrometrically enriched Eu^{152} was studied using a Siegbahn-Slätis beta ray spectrometer, a scintillation spectrometer, and a gamma-gamma coincidence device. From the analysis of the beta spectrum α_K of the 344 kev gamma radiation is found to be 0.033 ± 0.001. A low energy beta group- with an end point at 417 kev was found, and to fit this to the decay scheme it has been suggested that there is a 1415 kev level in Gd^{152} which decays entirely by an emission of a 1415 kev gamma ray. The α_K, K/L, and L/M values of the 122 kev gamma ray in Sm^{152} are compared with the theoretical values of Rose based on finite nuclear size. (auth)

16332

STUDIES OF ELECTRONS OF INTERNAL CONVERSION. Jan Zylicz (Inst. of Nuclear Studies, Warsaw). Postępy Fiz. 10, 425-44(1959) July-Aug. (In Polish)

A survey is given of investigations of internal conversion electrons. The properties, energy measurements, and theoretical computations of conversion electrons. The properties, energy measurements, and theoretical computations of conversion coefficients are reviewed. The bibliography includes many Western and some Soviet sources. (B.O.G.)

16333

ESTIMATION OF THE NUCLEAR MOMENT OF INERTIA AND THE g_R-FACTOR. Chin-yuen Tseng, Ching-ying Chang, and Li-ming Yang (Peking Univ.). Sci. Sinica (Peking) 9, 68-78(1960) Jan. (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 8991.

16334

THE MÖSSBAUER RADIATION. LOW-ENERGY GAMMA RAYS PROVIDE THE MOST PRECISELY DEFINED ELECTROMAGNETIC FREQUENCY YET DISCOVERED. Winston E. Kock (Bendix Aviation Corp., Detroit). Science 131, 1588-90(1960) May 27.

The history and application of Mössbauer radiation are discussed. (W.L.H.)

16335

ON ANGULAR DISTRIBUTION OF NEUTRONS IN $C^{13}(d,n)N^{14}$ REACTION. T. L. Abelishvili, T. G. Gachechiladze, and O. M. Mdivani (Tbilis State Univ., USSR) Zhur. Eksptl'. i Teoret. Fiz. 38, 631-3(1960) Feb. (In Russian)

Calculations were made of the angular distribution of neutrons in the $C^{13}(d,n)N^{14}$ reaction, experimentally studied by L. L. Green et al. (Proc. Phys. Soc. A68, 386, 1955), with incident deuterons of 0.86 Mev and four-group neutron resolution (g_0, g_1, g_2, and g_3), where first group corresponds to the finite nucleus N^{14} ground state and the rest to the finite nucleus transition to three initial excitation states. The results indicate that the ground state transition is described by Butler theory, considering the exchange interactions. The data on the two initial excitation state transitions are described by the spin reorientation process; in the third transition the spin reorientation process does not take place and only "heavy" stripping is observed. The magnitude of parameters used in the calculation are tabulated: $\alpha_D = 0.23 \times 10^{13}\ cm^{-1}$, $\alpha_H = 0.47 \times 10^{13}\ cm^{-1}$. (R.V.J.)

16336

SCHWINGER EFFECT CONSIDERING NUCLEAR SCREENING WITH ATOMIC ELECTRONS. V. M. Koprov. Zhur. Eksptl'. i Teoret. Fiz. 38, 639-41(1960) Feb. (In Russian)

Neutron magnetic moment interactions with nuclear electric fields influence neutron scattering by heavy nuclei at small angles. It is shown that screening considerably alters the angular distribution at very small angles. The relative magnitude of the screening correction is given. The corrections for screening are not as precise as the published angular measurements. (R.V.J.)

16337

STUDIES OF Nb^{95} AND Ce^{144} β RADIATION BY AIR ABSORPTION METHOD. N. E. Tsvetaeva and L. A. Rozenfel'd. Zhur. Eksptl'. i Teoret. Fiz. 38, 641-3(1960) Feb. (In Russian)

The absorption of Nb^{95} β radiation by air at various pressures is plotted. The energy of Nb^{95} β radiation is $E_0 = 0.166 \pm 0.004$ Mev. Measurements of Ce^{144} and Pr^{144} total β radiation are plotted. The exclusion of Pr^{144} (E = 3 Mev) from the total absorption curve in air at less than atmospheric pressure was carried out according to the absorption curve for Ru^{106}–Rh^{106}. The magnitude of the Ce^{144} air factor is 3.25, in contrast with the postulation of only one β component with an energy of ~0.3 Mev. An analysis of the K (E_0) dependence graphs and formulas revealed a component with energy $E_0 = (0.168^{+0.032}_{-0.020})$ Mev and abundance 40 ± 12%. (R.V.J.)

Particle Accelerators

16338 DESY-A2.56

Deutsches Elektronen-Synchrotron, Hamburg.

BERICHT ÜBER DIE AUFSCHLIESSUNGSBOHRUNG FUR DIE WASSERVERSORGUNG DER DESY-ANLAGEN. (Report on the Well Drilling for the Water Supply of the DESY Site). Cornelius. Feb. 17, 1960. Includes Appendixes: 1. GUTACHTEN ÜBER DIE MÖGLICHKEIT EINER EIGENWASSERVERSORGUNG FÜR DAS DESY-PROJEKT IN HAMBURG-BAHRENFELD. (Opinion on the Possibility of a Special Water Supply for the DESY Project in Hamburg-Bahrenfeld). J. Niedermayer. Aug. 20, 1958. 2. BERICHT ÜBER DIE ERGEBNISSE DER VERSUCHE ZUR HERSTELLUNG EINER EIGENWASSER-VERSORGUNG AUS DEM GRUNDWASSER AUF DEM GELÄNDE DES DEUTSCHEN ELEKTRONEN-SYNCHROTRONS IN BAHRENFELD. (Report on the Results of a Study on the Development of a Special Water Supply from the Ground Water of the Site of the German Electron-Synchrotron in Bahrenfeld). Nöthlich. 29p.

A report is presented of the site evaluation and selection and experimental borings for the water supply of the DESY electron-synchrotron installation. (T.R.H.)

16339 MURA-408

Midwestern Universities Research Assn., Madison, Wis.

REPORT ON SHIELDING THE MURA HIGH INTENSITY 50 MEV ELECTRON ACCELERATOR. James H. Smith. June 2, 1958. 15p. Contract AT(11-1)-384. OTS.

Shielding requirements of the 50-Mev electron accelerator being constructed at MURA are calculated. (auth)

16340 UCRL-9058

California. Univ., Berkeley. Lawrence Radiation Lab.

BEVATRON OPERATION AND DEVELOPMENT. XXIII.

[Period covered] August, September, October 1959. Walter D. Hartsough. Mar. 1960. 16p. Contract W-7405-eng-48. OTS.

The properties of an external prbton beam were studied and several emulsion exposures were made. A new secondary beam facility was completed at the north experimental area. The following particle physics program was carried out: Bubble chambers were used to study $p - \bar{p}$ interactions and K^+ decay modes and interactions; counter experiments were done to determine the $\pi^{\pm}$ – nucleon total cross section, the decay modes of Σ^+ and Λ^0 particles, $\pi^+ - p$ interactions, and $\Theta_1 - \Theta_2$ mass difference. Eighteen emulsion exposures to primary and secondary beams were made for seven external groups. Fifteen target bombardments were made in the primary proton beam for the Chemistry Department. (For preceding period see UCRL-9011.) (auth)

16341

CHARACTERISTICS OF A HIGH FREQUENCY ION SOURCE. Masao Seki, Akira Katase, Yoshihisa Wakuta, and Masateru Sonoda (Kyushu Univ., Fukuoka). Mem. Fac. Sci., Kyushu Univ. Ser. B 3, No. 1, 9-14(1960) Mar. (In English)

The characteristics of a high frequency ion source were investigated and compared with results previously obtained, especially for the canal geometry. The optimum is obtained when the depth of the canal tip from the upper end of the sheath is nearly equal to the inner diameter of the sheath. The relation between the ion beam and the high frequency power is investigated and it becomes clear that the high frequency power consumed in the ion source is the most effective and more than 300 watts are necessary in order to obtain the intense ion beam of a few milliamperes. (auth)

16342

IMPROVEMENTS RELATING TO THE IRRADIATION OF SUBSTANCES BY ELECTRONIC BOMBARDMENT. Michael Crowley Crowley-Milling (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 834,540. May 11, 1960.

An improved means of elongating the cross section of an electron beam is given. An assembly of magnetic poles is disposed about the beam axis with their axes radial to the beam axis. The magnetic fields tend to elongate the cross section of the beam along one lateral axis without changing the cross section along the opposite or perpendicular lateral axis. (T.R.H.)

16343

PARTICLE ACCELERATOR. L. C. Teng (to U. S. Atomic Energy Commission). U. S. Patent 2,922,061. Jan. 19, 1960.

A combination of two accelerators, a cyclotron and a ring-shaped accelerator which has a portion disposed tangentially to the cyclotron, is described. Means are provided to transfer particles from the cyclotron to the ring accelerator including a magnetic deflector within the cyclotron, a magnetic shield between the ring accelerator and the cyclotron, and a magnetic inflector within the ring accelerator.

16344

ION-STABILIZED ELECTRON INDUCTION ACCELERATOR. D. Finkelstein (to U. S. Atomic Energy Commission). U. S. Patent 2,929,951. Mar. 22, 1960.

A method and apparatus for establishing an ion-stabilized self-focusing relativistic electron beam from a plasma are reported. A plasma is introduced into a specially designed cavity by plasma guns, and a magnetic field satisfying betatron conditions is produced in the cavity by currents flowing in the highly conductive, non-magnetic surface of the cavity. This field forms the electron beam by induction from the plasma.

Plasma Physics and Thermonuclear Processes

16345 AD-235859

Stuttgart. Technische Hochschule. Institut für Hochtemperaturforschung.

DEVELOPMENT OF A DIAGNOSTIC DEVICE FOR THE DETERMINATION OF MEAN EFFECTIVE TEMPERATURES IN PLASMAS USING SHOCK WAVE MEASUREMENTS. Experimental Part of Interim Report Covering Research Carried out from January 1, 1959 through December 31, 1959. E. Hisam and W. Bez. Feb. 1960. 44p. Contract AF61(052)-199.

The development of a diagnostic plasma shock tube for the determination of mean effective temperatures in pulse discharges is described. The temperature and pressure in such a discharge is to be estimated from observations of the shock velocity in the tube. Methods of measuring the shock propagation velocity by using photocells are described. Required reproducibility of experiments was obtained by using an image converter with effective exposure times of approximately 10^{-7} sec. The electronic equipment developed for this diagnostic method is discussed and diagrams are presented. (auth)

16346 AERE-R-3229

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE STABILITY OF TWISTED MAGNETIC FIELDS IN A FLUID WITH FINITE ELECTRICAL CONDUCTIVITY. 2. SPECIAL RESULTS. R. J. Tayler. Feb. 1960. 30p. BIS.

A formal solution was previously given to the problem of the stability of an incompressible conducting fluid carrying a uniform axial current and a uniform axial magnetic field. No numerical results were obtained because of the extreme complexity of the transcendental dispersion relation. A complete solution was obtained earlier for a fluid of infinite conductivity, and it is shown that a solution can also be obtained when the conductivity is small and tends towards zero. The problem can also be solved for perturbation helices coinciding with the magnetic field helix. The system is more unstable for low conductivity than high conductivity (if the magnetic field is kept constant) and there are cases in which the system is stable for infinite conductivity but unstable for zero conductivity. The results given cannot be applied to a compressible plasma, but they can be applied to a liquid conductor such as mercury or liquid solium. The results for axisymmetric perturbations are compared with those obtained in an experiment described by Dattner at the Geneva Conference. The theoretical and experimental results appear to be in reasonable agreement. Such an agreement is not obtained for the m = 1 perturbations, but there are important differences between the experiment and the simple theory described. (auth)

16347 GA-1376

General Atomic Div., General Dynamics Corp., San Diego, Calif.

LONG-WAVELENGTH BEAM INSTABILITY. Marshall N. Rosenbluth. Apr. 21, 1960. 14p. Project No. 30. OTS.

The long-wavelength hose-instability of a neutralized relativistic beam immersed in a resistive plasma is treated. The beam is governed by the relativistic Boltz-

mann equation and the plasma by a simple Ohm's law. (W.D.M.)

16348 ML-665

Stanford Univ., Calif. Microwave Lab.

LANDAU DAMPING OF CIRCUIT AND ION WAVES. P. A. Sturrock. Jan. 1960. 17p. Project No. 47501. Contract AF49(638)-415. (AFOSR-TN-60-141; AD-233751).

It is shown that the interaction of a slow circuit wave with the thermal electrons of a plasma column should lead to dissipation of the circuit wave by the mechanism of Landau damping. Numerical estimates indicate that this effect should be susceptible to experimental verification. Such an experiment, if successful, would offer a method for determining the electron velocity distribution of a plasma column. A circuit analogue for the ion-acoustic-wave mechanism is derived which facilitates calculation of the Landau damping of ion waves. This effect is found to be small and cannot account for the difficulty experienced in attempting to set up these waves. It is suggested that a slow-wave circuit, in combination with a plasma column, might provide a suitable technique for investigating Van-Kampen waves and ion acoustic waves. (auth)

16349 NP-8679

Maryland. Univ., College Park.

SURFACE PLASMA OSCILLATIONS OF A DEGENERATE ELECTRON GAS. Technical Report No. 162. E. A. Stern and R. A. Ferrell. Dec. 1959. 27p. Contracts DA-49-170-sc-1837 and Nonr-1797-(00).

The anomalous characteristic energy losses of energy lower than the plasmon energy, exhibited by some metals, are attributed to quantized surface waves of the degenerate electron gas. Although the theory has been verified for an ideal pure metal, transmission experiments show a lower energy loss generally. This is accounted for by considering the relaxation produced by the oxide coating on the surface of the metal. It was concluded that a thin oxide coating (20 A) can produce a significant effect. It is established that a measurement of the dispersion of the energy loss versus angle of scattering in the transmission experiment would yield a measurement of the oxide film thickness. (W.D.M.)

16350 NP-8701

Space Technology Labs., Inc., Los Angeles.

INSTABILITY OF A PLASMA COLUMN CONFINED BY STANDING ELECTROMAGNETIC WAVES. Erich S. Weibel. [1958]. 14p.

The possibility of confining a cylindrical plasma column by the pressure of standing electromagnetic waves has been discussed previously. A circular wave guide which contains a coaxial plasma column is driven in the TM_{01} or TE_{01} made at cut-off, the intensity of the electromagnetic field being chosen such that its pressure balances the plasma pressure. In carrying out a stability analysis a few simplifying assumptions were made. The radiation pressure is a rapidly oscillating function but only its time average is taken into account. This can be justified, if the period of oscillation is much shorter than the transit time of a sound wave through the plasma. It is assumed that there exists a sharp boundary between the plasma and the confining field. (W.D.M.)

16351 SCTM-19-56(51)

Sandia Corp., Albuquerque, N. Mex.

CERTAIN NONLINEAR FLOWS OF MAGNETO-HYDRODYNAMICS. O. G. Owens. Feb. 3, 1956. 18p. Contract AT(29-1)-789. OTS.

In a previous paper (SCTM-214-55-51) a method was given for obtaining simple-wave solutions of a generalized Alfvén problem which was concerned with the magneto-hydrodynamics of fluid-like media capable of bearing an electric current and being acted upon by an external magnetic field. The method is applied to two definite initial-value problems of hydromagnetics with the equations of state $P = \rho^{5/3}$ and $P = \rho^{3}$. The resulting flows are completely specified by determining the velocity components and the shock fronts. (W.D.M.)

16352

NONLINEAR OSCILLATIONS AND NONSTATIONARY FLOW IN A ZERO TEMPERATURE PLASMA. PART I. INITIAL AND BOUNDARY VALUE PROBLEMS. G. Kalman (Israel Inst. of Tech., Haifa). Ann. Phys. (N.Y.) 10, 1-28(1960) May.

The individual motion of particles and the organized medium-like behavior determine the general motion of a zero temperature plasma. It is shown that a very strong interaction case corresponds to the linear approximation. Generally, however, the motion is governed by nonlinear equations. On applying a Lagrangian description and by transforming the equations into the coordinate system of the particles, the problem can be solved exactly. The general solution obtained may be fitted to any prescribed boundary or initial value. It is applied to such cases as the velocity modulated stream, oscillations of initial perturbations, and velocity modulation in space. Series expansion of the general solution leads to the familiar approximate solutions. At a certain value of the parameters the formation of electrostatic shock waves is possible. The criterion for the incidence of such shock waves is found, and certain features of their motion are given. The structure of the transformed differential equation shows that there is no wave-like propagation in the particles' coordinate system and generally no new particles participate in the motion. The concept of the distortionless oscillation, the result of the linear theory, in untenable in the exact treatment. (auth)

16353

NONLINEAR OSCILLATIONS AND NONSTATIONARY FLOW IN A ZERO TEMPERATURE PLASMA. PART II. GENERAL CHARACTERISTICS OF THE MOTION. G. Kalman (Israel Inst. of Tech., Haifa). Ann. Phys. (N.Y.) 10, 29-61(1960) May.

General nonlinear effects in plasma motion are investigated on the basis of a previous treatment. (1) A traveling-wave solution is studied and the adequate boundary and initial conditions for its excitation are investigated. The dispersion relation in approximation of any order is the same as in the linear theory. It can be shown, in virtue of the perturbation method applied, that in the case of a velocity distribution the result does not hold and nonlinear effects alter the dispersion relation. (2) An equipartition is derived between the particle energy and field energy. (3) The development of an original wave number and frequency spectrum is calculated. A procedure is outlined to calculate contribution of any order to the spectrum. The spectrum can be analyzed into higher harmonics of ω_0 and the only nonlinear effect in the development of the wave-number spectrum is the incidence of higher harmonics and no spectral decay or nonlinear dispersion relation exists. An analysis of the time variation of the energy content of the spectrum indicates a behavior analogous to the "constancy of big eddies" in hydrodynamical turbulence. The differences in the development of the frequency spectrum are in the lack of simple harmonic relation between wave numbers which transfer different parts of the spectrum, and in a relative stability of frequencies in the neighborhood of $\omega = \omega_0$ instead of $\kappa = 0$. (auth)

16354

UNSTEADY INCOMPRESSIBLE COUETTE FLOW IN A UNIFORM TRANSVERSE MAGNETIC FIELD. C. C. Mei (California Inst. of Tech., Pasadena). Appl. Sci. Research 9A, 275-84(1960). (In English)

The unsteady plane Couette flow of an incompressible, viscous, and infinitely conducting fluid in a uniformly imposed transverse magnetic field is studied. The problem is solved in general in a series form by means of a finite Fourier transform, and explicit solutions for two special cases are worked out. (auth)

16355

IONIC CYCLOTRON RESONANCE IN DENSE PLASMAS. L. V. Dubovio, O. M. Shvets, and S. S. Ovchinnikov. Atomnaya Energ. 8, 316-23(1960) Apr. (In Russian)

Plasma heating by ion cyclotron resonance is investigated. It is shown that the utilization of short (in comparison to the plasma column length) heating sections in plasma with charged particle density 10^7 to 10^{11} cm^{-3} reduces the effects of transverse ion polarization fields at the expense of discharge electron motion along the external magnetic lines. A strong drop in the efficiency of high-frequency field energy transmission to ions, with an increase in their velocity resulting from the cooling of ions by neutrals, was observed in plasma with a low degree of ionization. (tr-auth)

16356

OSCILLATIONS AND DIFFUSION IN WEAKLY IONIZED PLASMA. Jean-François Bonnal, Georges Briffod, and Claude Manus. Compt. rend. 250, 2859-61(1960) Apr. 25. (In French)

The diffusion of the particles of a weakly ionized plasma was observed in a direction perpendicular to the magnetic field. Above a certain value of this field, some oscillations appear and the regime of particle leaks is strongly increased. (tr-auth)

16357

MOTION OF A CONDUCTING PLASMA PROPELLED BY A PISTON. G. A. Skuridin and K. P. Stanyukovich (Shmidt Inst. of Geophysics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 131, 72-4(1960) Mar. 1. (In Russian)

Generalized equations derived for the asymptotic, one-dimensional plasma motion are applied in seeking parameters describing the motion of a conducting medium (plasma) propelled by a piston, with the piston motion $x_p = (at^2/2) = \psi(t)$. The region behind the strong shock wave is not considered. (R.V.J.)

16358

MEASUREMENTS OF FAST ION ENERGIES IN POWERFUL PULSE DISCHARGE. B. G. Brezhnev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Energet. i Avtomat. No. 2, 54-8(1960) Mar.-Apr. (In Russian)

A method of Thomson parabolas was used for measuring fast ions in a wide range of velocities and for accurately determining e/M. Photographic recordings of charged particles, the use of constant magnets in creating the magnetic field, and the use of dry elements in creating the electric field completely excluded the influence of powerful electromagnetic alignment. The analysis of a fast ion beam showed that fast ions in deuterium and hydrogen pulsed discharge plasma have a continuous velocity spectrum from 4 to 200 kev. It is also shown that accelerating processes in the plasma column, accelerating deuterons up to 200 kev, influence deuteron emissions in deuterium discharge. (R.V.J.)

16359

STABILITY OF UNIFORM PLASMAS WITH RESPECT TO LONGITUDINAL OSCILLATIONS. Peter D. Noerdlinger (California Inst. of Tech., Pasadena). Phys. Rev. 118, 879-85(1960) May 15.

It is possible to relate the dispersion formula for longitudinal oscillations in an infinite, uniform, collision-free plasma with no magnetic field to the complex potential of a line charge distribution on the real axis of the phase velocity ($u = \omega/k$) plane. If the initial velocity distribution integrated over directions orthogonal to the direction of propagation is $f_0(v)$ the plasma is stable if and only if

$$U(u) = P\int_{-\infty}^{\infty} \frac{f_0'(v)dv}{v-u}$$

is negative at the minima of $f_0(v)$ on the real axis, with unimportant exceptions. In particular it is shown that single-peaked distributions are stable, while those with very sharp (e.g., nondifferentiable) minima or with a zero of f_0 between two peaks are not. The charge analogy yields information on the wavelengths for which oscillations can grow and on rates of growth. Examples are given, including the case of two identical interpenetrating hot plasmas. A limited generalization to transverse oscillations is given. (auth)

16360

HYDROMAGNETIC STABILITY OF FLOW BETWEEN ROTATING CYLINDERS. R. J. Donnelly and M. Ozima (Univ. of Chicago). Phys. Rev. Letters 4, 497-8(1960) May 15.

The flow of an electrically conducting fluid was studied using the rotating-cylinder viscometer technique. The device is composed of concentric cylinders immersed in mercury. The inner cylinder is driven, while a torque is transmitted to the outer cylinder until the motion due to mercury is balanced. The effective viscosity of the fluid, which is proportional to the product of the torque and the period of rotation of the inner cylinder, is measured as a function of rotational speed. This curve shows a distinct change in slope at the critical rotation rate. The experimental results are plotted in comparison with theoretical by perfectly conducting cylinders and insulating cylinders showing the relations of the critical Taylor number T_c and Q. (B.O.G.)

16361

CONVENTION ON THERMONUCLEAR PROCESSES. SESSION ON THE DEVELOPMENT OF THERMONUCLEAR DEVICES IN BRITAIN. B. F. J. Schonland (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 1-2(1959).

Progress in experimental and theoretical work on thermonuclear research is presented. Discussions are included on the construction of Zeta, contributions from the U.S.A. and the U.S.S.R., engineering design problems associated with new systems, and constricted plasma and its future. Twenty-two papers are included. Separate abstracts have been prepared for 20. Two papers were previously abstracted in NSA. (B.O.G.)

16362

THE BASIC PHYSICS OF THERMONUCLEAR PROCESSES. T. E. Allibone and D. R. Chick (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 3-11(1959).

Density and temperature requirements are stated for which a radiation-cooled ionized plasma could yield a net power gain from fusion reactions in deuterium or deuterium-tritium mixtures. Containment of the plasma by electric or magnetic fields is shown to be essential, and

the behavior of the plasma in such fields is discussed. Magnetic mirror fields are discussed briefly, and an attempt is made to list the forms of wave motion which can occur in such a plasma. Some features of the self-pinched discharge are stated and the stability conditions for a possible model of such a pinched discharge are outlined. Attention is drawn to some experimental results tending to invalidate assumptions used in the theoretical formulation. (auth)

16363

SCEPTRE IIIA. A. A. Ware (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 30-5(1959).

The toroidal discharge apparatus Sceptre III has been modified and is now known as Sceptre III A; the modification included new magnetic-field coils and improved measurement facilities. The experimental results which have been obtained with Sceptre III A are reviewed. The evidence of many of the measurements suggests that the large electron-energy loss associated with this type of discharge is caused by an electron-particle loss to the tube walls. If this is correct, the observed Doppler broadening and Doppler shift of the ion spectral lines have simple explanations. A mechanism is suggested for the electron-particle loss. (auth)

16364

PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. R. M. Payne and S. Kaufman (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 36-42(1959).

An understanding of heavy-current discharges entails extensive measurement of the plasma. A review is given of some measurements with particular reference to the thermonuclear apparatus Sceptre III, although one of the categories of measurement is applicable to any hot gas containing deuterium. Emphasis is placed on instrumentation and on the physical basis of measurement. Limitations of and improvements to the methods and the modifications to be anticipated when the plasma temperature rises are indicated. Results of measurements not previously published, such as those on discharge stability and energy loss, are included. Although few of the measurements are completely reliable, several independent methods of measurement can yet provide a self-consistent and hence more trustworthy result. New methods of measurement are desirable to extend the present range. (auth)

16365

CHOICE OF MATERIALS AND PROBLEMS OF DESIGN OF HEAVY-CURRENT TOROIDAL DISCHARGE TUBES. A. E. Robson and R. Hancox (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 47-55(1959).

One of the principal problems of heavy-current discharges is the contamination of the plasma by material eroded from the walls of the discharge tube. Erosion may occur by thermal evaporation, sputtering and—in the case of metal walls—the formation of arcs. These processes are examined in detail, with particular reference to the conditions which may exist in a thermonuclear reactor working on the pinched-discharge principle. It appears that, for stable discharges of long duration, thermal evaporation and sputtering should not be serious if materials of low atomic number are used. In the more severe transient initial conditions, sputtering may limit the duration of the first stage of the discharge. Metals are superior to insulators in thermal properties and ease of fabrication, but tend to form 'unipolar' arcs when exposed to plasma. The mechanism of these arcs is discussed, and some experiments on the arcing properties of different materials are described. A critical review is given of a number of possible torus designs. (auth)

16366

VACUUM SYSTEM DESIGN. J. Blears and E. J. Greer (Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 56-61(1959).

The Zeta I vacuum system consists of a toroidal tube of 42 in. bore by 11 ft mean diameter fabricated from 1 in. aluminum plate with a 48-section insulated interleaved water-cooled liner made from $\frac{1}{8}$-in. aluminum sheet. The torus was split vertically, each half torus being mounted on a trolley with its vacuum pumps and ancillaries, and arranged in such a way that the whole system could easily be withdrawn from the transformer core for servicing or modification. Experimental work in 1957 and 1958 was not seriously limited by vacuum techniques, since loss due to radiation from impurities in the discharge appears to have been only about 20% of the energy input, but it is unlikely that a significant increase in temperature will be attained unless impurities in the discharge can be reduced by one or two orders of magnitude. (auth)

16367

SWITCHING AND CONTROL. M. A. Bird (Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 62-5(1959).

Reasons behind the decision to design a new compressed-air-operated mechanical switch for the Zeta circuit are outlined. The principal functions of the switch are given, and those factors which most affected the design are considered in more detail. Several hundred thousand discharges were initiated by the switch before its place, in the original Zeta circuit, was taken by ignitrons. Although Zeta is only an experimental apparatus, the scale and complexity of the equipment made a very comprehensive system of controls necessary. Interlocks and automatic sequence controls were provided, partly to prevent damage to personnel and equipment and partly to permit the speedy location of faulty apparatus. The necessity for carrying out test sequences of up to 3,500 discharges at 12 sec intervals has more than justified the decision to give special attention, from the earliest days, to the switching and control of the Zeta circuit. (auth)

16368

THE ZETA TRANSFORMER AND AUXILIARY CIRCUIT EQUIPMENT. E. R. Hartill (Metropolitan-Vickers Electrical Co., Ltd., Manchester, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 66-73(1959).

The design and construction of the Zeta high-power pulse transformer and its associated core-biasing circuit are outlined. Details are given of the pulse-shaping reactor and non-linear resistance unit with reference to the circuit calculations made on a high-speed digital computer, and of the saturable reactor which assists in the switching operation and the current transformers and voltage dividers which were supplied. The design of the stabilizing axial-field winding is discussed. (auth)

16369

THE MODIFICATION OF ZETA IN 1958. J. T. D. Mitchell, H. R. Whittle, E. M. Jackson, and P. B. Clarke (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 74-81(1959).

Modifications were carried out on Zeta to improve per-

formance of the equipment in scientific and engineering aspects. These comprise installation of a stainless-steel bellows liner in the torus, ignitron switching and simplification of the pulse circuit, and improved vacuum pumping, stabilizing field, and diagnostic facilities. The machine, now known as Zeta 1A, is again in operation and further experiments are in progress. (auth)

16370

THERMONUCLEAR RESEARCH IN THE UNITED STATES OF AMERICA. C. M. Van Atta (Univ. of California, Berkeley and Livermore). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 85-94(1959).

A description is given of the controlled thermonuclear program in the United States. It is seen that this program is in a very early state of learning what is important and developing experimental techniques required to make further progress. The lecture includes discussions of: the Stellarator; the magnetic-mirror machine; the pinch and other impulsive devices; and the Astron device. (B.O.G.)

16371

STUDIES OF TRAPPING FAST CHARGED PARTICLES IN A CONSTANT MAGNETIC FIELD. I. N. Golovin (Atomic Energy Inst., Academy of Sciences, USSR). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 95-9(1959).

The trend in the research aimed at producing controlled thermonuclear reactions in the U.S.S.R. is discussed. This trend began to develop after Budker suggested, in 1953, the use of magnetic mirrors, analyzed several possible methods of obtaining hot plasma, and calculated the loss of ions through the magnetic mirrors in terms of particle collisions. The Rodionov and Ogra experiments are discussed. The Rodionov experiment was conducted to determine whether the current theory of motion of an individual particle is applicable for many reflections from magnetic mirrors. The Ogra installation was constructed to study whether dense hot plasma will be stable in mirror machines. (B.O.G.)

16372

THE CALCULATION OF DISCHARGE CURRENTS IN A TORUS WITH A CONTINUOUS CONDUCTING LINER. C. H. Tosswill and E. L. V. Hope (Atomic Energy Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 101-6(1959).

A continuous metallic liner was introduced into the Zeta torus. The parasitic current flowing in this liner will limit the permissible rate of current increase in the discharge. The behavior of the system when gas and liner currents are of the same order must be calculated and for this purpose an equivalent circuit is established. In a first analysis, all the elements in this circuit are assumed to be constant throughout the discharge, and the currents flowing are found by normal interpretation of the appropriate third-order differential equations. These results are useful for machine trials, and provide a check on the second stage of analysis in which the variation of the inductance of the gas during the pulse is taken into account. This second calculation is of course much more difficult than the first, and is performed with a digital computer. The computer has now examined the conditions which are of immediate interest, and has shown that in all of them the energy loss in the liner can be tolerated. Sufficient data are now available for deduction of the discharge parameters to be made from experimental results. (auth)

16373

SOME SWITCHING PROBLEMS IN THERMONUCLEAR RESEARCH. D. L. Smart (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 107-16(1959).

The switching studies and development work in progress at Harwell form a service to a developing and changing research programme; their objective must have available for use as required a range of switches with a wide and flexible field of application. The most typical switching problem in thermonuclear research is that of transferring a large amount of energy quickly from an energy store to an inductive load, and then maintain the load current at or near its peak value for a comparatively long period. The requirements of the simple LC circuit with 'clamping' switch can be met by various combinations of spark gap, vacuum arc, and mechanical making switches; some of these arrangements and their practical limitations are discussed. The use of inductive energy storage will require circuit-breakers, which may have to be of large breaking capacity and designed for frequent operation; several alternative circuit arrangements for providing a current zero are possible. (auth)

16374

RAPID COMPRESSION OF A PLASMA WITH AZIMUTHAL CURRENTS. G. B. F. Niblett (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 152-7(1959).

A rapid pinch process is discussed in which azimuthal currents and their associated axial magnetic fields are used to heat and confine a plasma. A simple one-dimensional model of the fast pinch process is used to show how the temperature attained by the plasma depends upon the discharge parameters and in particular that the energy per particle is proportional to the electric field developed across the plasma surface. Previous work on this form of pinch effect is reviewed and an account is given of preliminary experiments at the Atomic Weapons Research Establishment (A.W.R.E.). The principal features of a toroidal system using azimuthal currents and axial fields to heat and subsequently confine a plasma is presented and the advantages and consequences of this configuration are examined, particularly as compared with a torus using axial currents. After the initial rapid heating process the plasma and magnetic field diffuse into each other and the configuration is similar to that in the Stellarator, with similar stability problems and similar possibilities of continuous operation. (auth)

16375

THE CIRCUIT DYNAMICS OF PLASMA. B. S. Liley (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 158-65(1959).

Equations applicable to the behavior of plasma in bulk are derived and discussed. Starting with the equations of plasma dynamics the total and thermal energy equations are integrated over all space. Certain bulk variables such as the geometrical dimensions of a conductor and the total charge in a circuit are then introduced. Subsequent definition of various circuit parameters and the introduction of generalized e.m.f.'s permit the integrated equations to be expressed in terms of the bulk variables. Using the fact that the total energy is constant, it is possible to obtain the equations of circuit dynamics, applicable to a plasma, in Lagrangian form. The derivation is not rigorous, relying for its validity on physical arguments and the consistency of the final equations with those of plasma dynamics. Again, the proof is confined to cases in which the nature of the functions determining the distribution of mass, current and charge density throughout the volume of a con-

ductor are time-independent. The generalized e.m.f. concept is unfamiliar; it mainly arises from coupling between the electrical and thermal properties of a plasma. It is shown that these e.m.f.'s lead to a form of magneto-resistive coupling and, even in the absence of Hall currents, an apparent anisotropic resistivity. A general proof of the equivalent transformer circuit is given. (auth)

16376

ENERGY STORAGE FOR THERMONUCLEAR RESEARCH. R. Carruthers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 166-72(1959).

The basis of most British work on controlled fusion is the pinch effect, and the experiments are essentially pulse operated. Many other suggested thermonuclear devices are pulse operated or use pulsed model experiments to limit the mean-power requirements. To operate such pulsed experiments, where energy is often required at very high levels, it is usual to 'charge' a suitable energy store over a long period—several seconds. This energy is then discharged into the experimental 'load' in a period which may be a few microseconds or an appreciable fraction of a second. Energy may be stored as electric charge, magnetic flux, mechanical energy or chemical energy, and these various methods are considered. It is shown that storage as electric charge in a capacitor is most suitable where a rapid discharge is required. Magnetic storage as current in an inductance has its greatest usefulness where energy is required for periods of milliseconds, while machines and batteries are more appropriate to the longer pulses. For large-scale experiments the energy store can be a large fraction of the capital cost and an economic study of the various possibilities is important. It is suggested that a reasonable price for an energy-storage system has been achieved when the capital cost is of the same order, or less, than the cost of the electrical energy to be passed through it in its designed life. (auth)

16377

POSSIBILITIES OF DIRECT ENERGY CONVERSION FROM FUSION REACTORS. J. D. Jukes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 173-6 (1959).

A method is suggested for extracting electrical energy directly from fusion reactors, and it is shown that about one-third of the available energy may be so extracted. In a power reactor, modulated currents of at least 8 ma are required with optimum fuel, purity and other conditions. (auth)

16378

RAPID HEATING FOR CONTROLLED FUSION RESEARCH. R. A. Fitch (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Inst. Elec. Engrs. (London), Pt. A 106, Suppl. 2, 177-82(1959).

The reasons for seeking a means of rapidly heating a plasma to thermonuclear temperatures are discussed, and it is suggested that shock compression by a rapidly increased magnetic field is a possible method. The problems of producing and maintaining such fields are considered, and it is concluded that capacitor discharge banks with the minimum inductance are required for both phases. The design of low-inductance condenser banks is discussed and it is suggested that the maximum rate of current rise attainable with presently available materials is about 10^{14} amp/sec. (auth)

16379

INVESTIGATIONS OF SPATIAL DISTRIBUTION OF PARAMETERS OF HIGH FREQUENCY DISCHARGE IN HELIUM AND ARGON. Kh. A. Dzherpetov, P. S. Bulkin, and A. R. Akhmedov. Vestnik Moskov. Univ. Ser. Mat., Mekhan., Astron., Fiz. i Khim. 3, 71-81(1959). (In Russian)

The distribution of discharge parameters and the characteristics of charged particle motion in the immediate region of the electrode were investigated. The temperature and electron gas concentrations in argon at 12 MHz were measured by the method of spatial distribution produced by spatial charges in high-frequency discharge. The direct probe method was used for determining the characteristics of electron motions in the initial stages of discharge in helium at 5 MHz. (R.V.J.)

16380

THERMONUCLEAR FUSION RESEARCH FOR POWER. Leonard J. Linde (C Stellarator Associates, Princeton, N. J.). p.51-9 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

The fusion research program is discussed, including promising approaches being used and an outline of the major problems. The performance characteristics of the C Stellarator are discussed. (B.O.G.)

16381

DYNAMICS OF CONDUCTING GASES. PROCEEDINGS OF THE THIRD BIENNIAL GAS DYNAMICS SYMPOSIUM. Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press. 1960. 220p.

Eighteen papers on plasma physics, plasma dynamics, and magnetohydrodynamics are presented. The book as a whole is divided into four parts dealing with processes and properties in ionized gases, interaction of magnetic fields and flow of ionized gases, laboratory manipulation of ionized gases, and application of magnetohydrodynamic effects. (D.L.C.)

16382

THE CONDUCTIVITY OF AN IONIZED GAS IN A MAGNETIC FIELD. W. P. Allis (Massachusetts Inst., of Tech., Cambridge) and S. J. Buchsbaum (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.3-14 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

A Lorentzian plasma (infinitely heavy ions at rest) is examined first for the particular case of electrons and singly ionized ions and an expression for the conductivity is developed. In addition, the transport equations for both ions and electrons are defined and simplified, taking into account ion motion. This latter case requires certain assumptions but the gross behavior of the plasma should be correctly represented. A discussion of non-neutral plasmas is included but only for particular cases in various limits. (auth)

16383

THE STATISTICAL MECHANICS OF THE APPROACH TO EQUILIBRIUM IN GASES. I. Prigogine (Université Libre, Brussels and Northwestern Univ., Evanston, Ill.). p.25-31 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The main concepts underlying a recent statistical mechanical theory of irreversible processes are discussed in qualitative terms. The relation between the nature of the

forces between the particles and the way in which statistical equilibrium is reached is considered in some detail. (auth)

16384

IRREVERSIBLE PROCESSES IN A PLASMA: EFFECT OF LONG RANGE FORCES. Radu Balescu (Université Libre, Brussels). p.32-5 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The well-known divergences appearing in the calculation of transport coefficients of a plasma may be eliminated without any need of an arbitrary cut-off if one starts from a transport equation which takes into account correctly the long range of the electrostatic interactions. Such an equation can be derived from first principles by applying the statistical mechanical methods developed by Prigogine and Balescu. The characteristic property of this equation is its collective character. The main consequences of this property are discussed. (auth)

16385

RELAXATION PROCESSES IN PLASMA. H. F. Calcote (AeroChem Research Labs., Inc., Princeton, N. J.). p.36-47 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The rate at which a gas in a state of non-equilibrium ionization approaches the equilibrium condition can be described by relaxation times characteristic of the various elementary processes. These processes are ion recombination, electron attachment, charge exchange, diffusion, and electron temperature decay. Techniques are reviewed and applied analytically to combustion flames. (auth)

16386

SOME SOLUTIONS OF THE MACROSCOPIC EQUATIONS OF MAGNETOHYDRODYNAMICS. W. R. Sears (Cornell Univ., Ithaca, N. Y.). p.51-63 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

A report is made on three different theoretical investigations concerning magnetohydrodynamics of inviscid incompressible fluids. These three studies concern the following cases: (1) Thin airfoils and slender bodies in fluids of moderate conductivity; this pertains to flows having uniform, parallel magnetic and velocity fields in the undisturbed region. (2) An inviscid magnetic boundary layer; this is a nonlinear treatment for fluids of large but finite conductivity and also involves the case of uniform, parallel fields in the free stream. (3) Some flows involving tensor conductivity; here some flows previously studied, namely steady flow past a corrugated wall and one-dimensional wave propagation (Alfvén waves) are generalized for a fluid in which the Hall effect is appreciable. (auth)

16387

MAGNETOHYDRODYNAMICS IN THE LIMIT OF SMALL INERTIAL FORCES. Rudolf X. Meyer (Space Tech. Labs., Inc., Los Angeles). p.80-5 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The continuum theory of electrically conducting fluids is considered for the case in which inertial forces are negligible compared with pressure gradients and ponderomotive forces. The pressure is constant along field lines, and the flow of an ideal gas is isothermal. The field lines are found to be characteristics for the determination of the stream function. An application to the fluid mechanics of plasma propulsion and electromagnetic shock tubes is indicated. The rate of leakage of an ionized gas through a two-dimensional "magnetic piston" is computed in detail. (auth)

16388

AXIALLY SYMMETRIC HYDROMAGNETIC CHANNEL FLOW. F. D. Hains, Yusuf A. Yoler, and Edward Ehlers (Boeing Aircraft Co., Seattle). p.86-103 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The channeling effect of the magnetic field produced by a circular loop of wire on the steady state flow at low magnetic Reynolds numbers of an electrically conducting compressible gas in a circular channel of constant radius coaxial with the magnetic field is analyzed. Numerical results to the exact equations are given when the flow is supersonic. Formal solutions are given for subsonic and supersonic flow linearized for small values of the magnetic interaction parameter. Shock-tube investigations of wall pressures are discussed. (auth)

16389

EXPERIMENTAL STUDIES ON PLASMA DYNAMICS. Winston H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.) and John Nankivell, Samuel Koslov, and George Schmidt. p.107-11 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The mechanics of the extraction of electrical power from a moving plasma can be studied by using two parallel plates between which the plasma can be projected across a magnetic field. This electromagnetic brake can then be used to measure the internal resistance of the plasma between these plates. Once the internal resistance has been measured, it is then possible to determine the plasma density from the measured RC decay time. Two limited area probes utilizing the electric field as the driving potential may be used to measure the saturated ion current. Also, two probes may be used to measure the Hall electric field. Experimental verification of the above techniques was made and, although additional refinement is necessary, the experimental results agree with calculated values within an order of magnitude consideration. (auth)

16390

APPLIED MAGNETOHYDRODYNAMICS AT AVCO-EVERETT RESEARCH LABORATORY. M. Camac and G. S. Janes (Avco-Everett Research Lab., Everett, Mass.). p.112-25 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The research conducted at Avco-Everett Research Laboratory in magnetohydrodynamics (MHD) is described; the emphasis is on electrical power generation and propulsion devices. A low-temperature MHD electric power generator is described in some detail; power losses in its operation are discussed and its characteristics are plotted as a function of the gas conductivity and design power output. A device was constructed for the study of the performance of a simulated MHD generator; argon seeded with K_2CO_3 was used. Flight applications of MHD were studied with analysis of various flow situations, especially

that with no solid bodies in the flow which was approximated using the magnetic field of a loosely wound circular solenoid with its axis at right angles to the flow. The results show that significant life forces can be created for symmetric bodies, using the Hall effect. Space propulsion was investigated, and the arc jet and pulsed magnetic annular shock tube (MAST) are described. Experiments with helium as the working fluid in the arc jet gave specific impulses up to 1150 seconds and wind tunnel efficiencies of 65 and 50% for specific impulses of 600 and 1100 seconds, respectively. On the other hand, the MAST gave specific impulses of 10,000 to 20,000 seconds, and the light emitted by the gas behind the shock wave can be used to determine the shock velocity and the state of the gas behind the shock wave. The MAST was used for research on plasma whose particle interactions arise through the magnetic field rather than interparticle collisions; the shock thickness in such a case was measured for hydrogen. A method is developed for the generation of shock waves with a thickness smaller than the mean free path of the molecules. (D.L.C.)

16391

TECHNIQUES FOR PRODUCING PLASMA JETS. James A. Browning (Thermal Dynamics Corp. and Dartmouth Coll., Hanover, N. H.). p.126-38 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The production of partially ionized gases on a continuous basis is discussed. The resulting "plasma" resembles an extremely hot flame and is adaptable as a heat source to a variety of applications. Temperatures approaching 60,000°F are possible. Plasmas may be produced by any one of several different techniques. Intensely hot thermal regions exist behind strong shock waves. The gas in this region is partially ionized to form a plasma. The shock front is not presently applicable to the continuous formation (at a fixed spatial location) of plasma. The electric arc as a plasma generator is presently being given the major amount of attention, and several forms of plasma-producing devices have been developed. Applications and patent inventions in the plasma field are given. (auth)

16392

ELECTROMAGNETIC SHOCK TUBES. Richard W. Ziemer (Space Tech. Labs., Inc., Los Angeles). p. 139-49 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The development of the electromagnetic shock tube is followed from the T-tube arrangement first used by Fowler in 1951 through to the presently used forms of the T-tube and coaxial tapered tube devices. The operating principles and the advantages of the various types are presented. The construction details of a tapered tube type apparatus are discussed and the important design considerations are indicated. The important diagnostic techniques are surveyed, including event timing, photographic analysis, electrical conductivity measurements and spectral analysis. Finally, the potentialities and limitations of the electromagnetic shock tube are briefly discussed. (auth)

16393

SPACE PROPULSION ENGINES, A PROBLEM IN PRODUCTION OF HIGH VELOCITY GASES. M. L. Ghai (General Electric Co., Evendale, Ohio). p.168-77 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

A basic problem of space propulsion engines is to generate gases at very high velocities, about 8 to 100 times the gas velocities generated by the conventional jet engines. Three electric propulsion engines inherently capable of producing the required velocities are presented: the electro thermal propulsion or the arc jet engine, the plasma propulsion or the magnetohydrodynamic engine, and the ion propulsion engine. Ability to generate high velocity gases enables these engines to make large savings in propellant consumption and deliver increased payloads as compared to chemical rockets. They also provide precise thrust regulation because of the inherent controllability of electric power. There is one basic difference between the chemical rockets and the electric engines. In chemical rockets, thrust can be increased by merely making the engine bigger, so they operate at the highest possible specific impulse to minimize the propellant consumption. In electric engines, however, the thrust and specific impulse cannot be generated independently and to obtain large thrust one must lower the specific impulse. Thus, one must be able to operate at all specific impulses to provide various thrust ranges. (auth)

16394

THE ELECTROMAGNETIC PINCH EFFECT FOR SPACE PROPULSION. Alfred E. Kunen and William McIlroy (Republic Aviation Corp., [Farmingdale, N. Y.]). p.178-89 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The phenomenon of the electromagnetic pinch effect is used to accelerate ionized gases for space propulsion. Electrical energy, initially stored in capacitors, is discharged across two nozzle shaped electrodes wherein the radial pinch is converted to axial motion of the effected gases instead of confinement at the axis. The gas dynamics of a pinch using the hydrodynamical model of a "magnetic piston" driving a shock wave is combined with the electrodynamics of the circuit to calculate the behavior of the discharge. Experiments on three different electrode designs are discussed and the results obtained are compared with the calculated values. The results of the study are applied to one particular space propulsion system consisting of a nuclear energy source, a space radiator, a turbine-generator, capacitor, and a pinch tube. The specific mission analyzed is a one-way unmanned flight to a Mars orbit, starting from an Earth orbit. (auth)

16395

PLASMA ACCELERATION BY GUIDED MICROWAVES. Robert V. Hess and Karlheinz Thom (National Aeronautics and Space Administration, Langley Field, Va.). p.190-200 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

A scheme of plasma acceleration is explored which makes use of the radiation pressure of guided microwaves to apply forces for plasma acceleration. The success of such a scheme depends on the recent development of microwave generators of extreme power outputs which, in the near future, should reach 100 Mw. The radiation pressures thus obtained are further increased by storing the radiation by resonance in a finite volume, which is bounded on one side by a plasma. The scheme may show certain advantages over other methods when the accelerated plasmas are of comparatively small mass and are accelerated to extreme ve-

locities. Possible applications of such plasmas for studies of certain aspects of thermonuclear fusion, propulsion, and communications are discussed. (auth)

16396

CONSIDERATIONS IN THE DESIGN OF A STEADY DC PLASMA ACCELERATOR. George P. Wood (National Aeronautics and Space Administration, Langley Field, Va.) and Arlen F. Carter. p.201-12 of "Dynamics of Conducting Gases. Proceedings of the Third Biennial Gas Dynamics Symposium." Ali Bulent Cambel and John B. Fenn, eds. Evanston, Ill., Northwestern University Press, 1960.

The design of a steady-flow d-c plasma accelerator involves consideration of many factors or problems, the solutions to some of which are described. These problems include seeding of the gas, production of ionization, prevention of recombination, prevention of buildup of space charge, thermionic emission from poisoned cathodes, consideration from a macroscopic point of view of the driving force as $j \times B$ per unit volume where j is one component of electron current, consideration from the microscopic point of view of the driving force as due to impact of heavy positive ions, proper tailoring of electric and magnetic fields and mean free times to result in desired portions of ions' and electrons' trochoids, angle of electric field required to prevent loss of ions at the wall and to produce axial acceleration, etc. Most problems appear to be satisfactorily solved, and a model of the accelerator now under construction is described. (auth)

16397

PLASMA PHYSICS. J. G. Linhart. New York, Interscience Publishers Inc., 1960. 288p. $7.00.

Plasma physics is concerned with the behavior of systems of many free electrons and ionized atoms where the mutual Coulomb interactions cannot be disregarded. Systems of this type are examples of a medium known as a plasma which in many respects behaves differently from the solid, liquid, and gaseous states of matter. Plasma physics uses two complementary modes of description: the analysis of the movement of a single particle, and the fluid mode. These modes of description are applied to equilibrium configurations, to wave-motion and instabilities, and to shocks and motion of plasma bunches. A description is given of the various collision, diffusion, and radiation processes that are operative in establishing an equilibrium configuration in a plasma. These plasma process models are used to describe applications of plasma physics to research on controlled fusion of light nuclei, to electronics, and to other problems in applied physics and engineering. (B.O.G.)

16398

EXPERIMENTS WITH HIGH INTENSITY ELECTRIC DISCHARGES. G. M. Giannini, A. C. Ducati, W. F. von Jaskowsky, and D. Ragusa (Plasmadyne Corp., Santa Ana, Calif.). p.21-32 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

Investigations of high-temperature heating processes are described. Included are discussions on methods of producing plasmas, plasma diagnostic measurements, and a number of applications. (J.R.D.)

16399

HIGH TEMPERATURE RESEARCH ACTIVITY IN GERMANY. Walter Lochte-Holtgreven (Kiel Univ.). p.272-6 of "Proceedings of an International Symposium on High Temperature Technology, Asilomar Conference Grounds, California, October 6-9, 1959." New York, McGraw-Hill Book Company, Inc., 1960.

A review of plasma research is presented. It is noted that development in other high-temperature fields was inhibited due to the lack of demand for materials to be used in aero-space projects and in reactor development. (J.R.D.)

16400

APPARATUS FOR HEATING IONS. E. S. Chambers, A. A. Garren, D. O. Kippenhan, W. A. S. Lamb, and R. J. Riddell, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,920,236. Jan. 5, 1960.

The heating of ions in a magnetically confined plasma is accomplished by the application of an azimuthal radiofrequency electric field to the plasma at ion cyclotron resonance. The principal novelty resides in the provision of an output tank coil of a radiofrequency driver to induce the radiofrequency field in the plasma and of electron current bridge means at the ends of the plasma for suppressing radial polarization whereby the radiofrequency energy is transferred to the ions with high efficiency.

Shielding

16401

THE RADIATION FROM A CYLINDRICAL SOURCE BEHIND A FLAT SHIELD. D. P. Osanov and E. E. Kovalev. Atomnaya Energ. 8, 374-6(1960) Apr. (In Russian)

Radiation produced in multiple scattering (using aqueous cobalt sulfate solutions) in front of a shield of $\mu_2 d > 2$ to 2.5 was a small fraction of that behind the shielding. The dosage from multiple scattering may be calculated using the equivalent absorption length and the point source accumulation factor. The maximum difference between experimental and calculated data with $\mu_2 d < 2$ to 2.5 did not exceed 30%. (R.V.J.)

Theoretical Physics

16402 AEC-tr-3852

PROBLEMS OF DYNAMIC THEORY IN STATISTICAL PHYSICS. (Problemy Dinamicheskoĭ Teorii v Statisticheskoĭ Fiziki). N. N. Bogoliubov. Translated by Lydia Venters (Argonne National Lab.) from a Publication of the Federal Publishing House for Technical-Theoretical Literature, Moscow-Leningrad, 1946. 115p. OTS.

The formulation of general methods for the solution of kinetic equations in statistical physics by dynamic theory is presented. Systems, based on the canonical distribution of Gibbs, in the state of statistical equilibrium are investigated. Two types of power expansions were studied; one led directly to the known expansions of the theory of real gases of Ursell-Mayer and the other to Debye formulas in the first approximation in the theory of powerful electrolytes. Special methods for power expansions which lead to kinetic equations are discussed. To characterize the dynamic theory, a sequence of distribution functions which characterize the probable distribution for the complexes of $s(s = 1,2,3,\ldots)$ molecules was introduced and a system of integro-differential equations was composed for them. The motion of molecules is discussed as an incidental process and a mechanism of binary collisions is introduced. The effective cross sections in the equation of the incidental process are computed from the equations of classical mechanics. (C.J.G.)

16403

FORMULATION OF QUANTUM STATISTICAL ME-

CHANICS AS A FUNCTION OF THE OCCUPATION NUMBERS. Roger Balian, Claude Bloch, and Cyrano De Dominicis (Centre d'Études Nucléaires, Saclay, France). Compt. rend. 250, 2850-2(1960) Apr. 25. (In French)

The introduction of a self-consistent potential, the use of representation diagrams dependent on time between 0 and β, and the application of an algebraic theorem on the operators of creation and absorption permit the simple expression of the thermodynamic magnitudes as a function of the occupation number for a quantum system. (tr-auth)

16404

ON THE MULTIPLICITY OF INTERPOLATING FIELDS TO A CAUSAL S-MATRIX. H. -J. Borchers (Universität, Hamburg). Nuovo cimento (10) 15, 784-94(1960) Mar. 1. (In German)

Local commutativity of different fields is shown to be a transitive property of fields. A criterion is derived which decides whether two local fields are interpolating fields to the same S-Matrix or not. It is shown that there exists more than one interpolating field to a given causal S-Matrix. (auth)

16405

SIGNIFICANCE OF POTENTIALS IN QUANTUM THEORY. W. H. Furry and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev. 118, 623-6(1960) May 1.

The effects of the scalar and vector potentials in quantum mechanics. which were pointed out recently by Aharonov and Bohm, are discussed from the point of view of the consistency of the quantum-mechanical description of interference experiments. A well-known requirement for this consistency is that if any measuring device is introduced that can be used to determine which path the particle has taken, it must have the effect of eliminating the interference phenomenon. Two conceptual experiments are discussed, corresponding to the two phase effects noted by Aharonov and Bohm. In each case it is found that the phase effect is of just the magnitude required to destroy the interference pattern when the circumstances are such that no pattern should be observed. (auth)

16406

HIGH-ENERGY BEHAVIOR IN QUANTUM FIELD THEORY. Steven Weinberg (Columbia Univ., New York). Phys. Rev. 118, 838-49(1960) May 1.

An attack is made on the problem of determining the asymptotic behavior at high energies and momenta of the Green's functions of quantum field theory, using new mathematical methods from the theory of real variables. A class A_n of functions of n real variables, whose asymptotic behavior may be specified in a certain manner by means of certain "asymptotic coefficients" is defined. The Feynman integrands of perturbation theory (with energies taken imaginary) belong to such classes. It is then proved that if certain conditions on the asymptotic coefficients are satisfied then an integral over k of the variables converges, and belongs to the class A_{n-k} with new asymptotic coefficients simply related to the old ones. When applied to perturbation theory this theorem validates the renormalization procedure of Dyson and Salam, proving that the renormalized integrals actually do always converge, and provides a simple rule for calculating the asymptotic behavior of any Green's function to any order of perturbation theory. (auth)

16407

STRUCTURE OF NUCLEAR MATTER. A. W. Overhauser (Ford Motor Co., Dearborn, Mich.). Phys. Rev. Letters 4, 415-18(1960) Apr. 15.

Equations for explicit Hartree states of energy lower than that of conventional ground states for noninteracting Fermi gases are given for Fermi gases with attractive interactions. One-dimensional and three-dimensional cases are treated. Large static density waves are shown to exist in such Fermi gases, and the binding energy is derived therefrom. If the density waves are used with the variational theorem, their contribution to the binding energy is greater, and it is concluded that density waves are of great importance in nuclear matter. In the limit of weak attractive interactions, the Fermi surface will become a many-faced polyhedron, each pair of opposite faces arising from a density wave. (D.L.C.)

REACTOR TECHNOLOGY

General and Miscellaneous

16408 AAEC/E-43

Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales.

A DERIVATION OF THE EFFECTIVE RESONANCE INTEGRAL IN HETEROGENEOUS SYSTEMS. A. Keane, M. H. McKay, and C. D. Cox. Aug. 1959. 28p.

An evaluation of the effective resonance integral for a close-packed lattice of fuel elements in beryllium oxide moderator was made. The usual theory of resonance absorption was extended to allow for flux depression in the moderator. The fuel elements under consideration consist of clusters of seven rods, so that it is necessary to determine the effective surface area for such a cluster. When the fuel elements are composed of U^{235}, Th^{232}, and Be atoms in the ratio of approximately 1 : 35 : 1200 and the BeO moderator occupies almost three and a half times the volume of the fuel rods, the effective resonance integral was found to be about 60% of the value for a homogeneous system of the same composition. (auth)

16409 ANL-6086

Argonne National Lab., Lemont, Ill.

THERMAL SHOCK TESTS OF A PLATE-TYPE NUCLEAR SUPERHEATER FUEL ELEMENT DESIGN. R. J. Gariboldi. Mar. 1960. 14p. Contract W-31-109-eng-38. OTS.

The degree of damage resulting from flooding of nuclear superheater fuel elements is dependent upon many factors. To gain general experience and to determine which factors are of primary importance, a series of crude tests were carried out as part of the coördinated effort to obtain operating procedures and design data for the BORAX nuclear superheater core. The fuel plates are fully enriched UO_2 in a stainless steel matrix. clad with stainless steel. (W.D.M.)

16410 CF-60-3-12

Oak Ridge National Lab., Tenn.

PRELIMINARY HOT SPOT ANALYSIS OF THE HFIR. Neil Hilvety. Mar. 1, 1960. 42p. OTS.

The effects of variations in HFIR design tolerances and uncertainty factors on hot spot, hot channel, and burnout margin factors have been calculated via the IBM 704. Graphs are presented of hot spot and hot channel factors and burnout margin factors as a function of each of these variables. These graphs may be used in establishing permissible design tolerances, and to calculate over-all hot spot, hot channel, and burnout margin factors. Also included are plots showing the effects of operating pressure

and flow variations on burnout. Based on the current HFIR core design, the maximum fuel plate (oxide surface) temperature is estimated to be 362°F with a maximum hot spot heat flux of 1.4×10^6 Btu/hr-ft^2. The minimum burnout heat flux for this reactor geometry is calculated to be a factor of 2.51 above the maximum operating heat flux. (auth)

16411 CNC-26

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.
ALCUNE PROPRIETÀ DEL REATTORE A DOPPIO CORE—ANALISI PARAMETRICA SUL FATTORE DI CONVERSIONE E DELL'ECCESSO DI REATTIVITÀ INIZIALE DEL CORE INTERNO. (Some Properties of Two-core Reactor—Parametric Analysis of Conversion Factor of Excess of Inner-core Initial Reactivity). D. Baroncini. Mar. 1960. 14p.

A parametric analysis was made of the conversion factor in a two-core reactor. Possible inner core reactivities associated with corresponding values of conversion factor were studied. (auth)

16412 CNC-28

Italy. Comitato Nazionale per le Ricerche Nucleari, Rome.
CALCOLI DI REATTIVITÀ REATTORI A DUE E PIÙ REGIONI. (Reactivity Calculations for Two- and Multi-region Reactors). L. Sani. Mar. 1960. 67p.

The dual problem relative to the calculation of the criticality factor k_{eff} in a non-critical reactor, i.e., in a reactor whose dimensions are different from the critical ones is considered. The determination of the criticality factor is reduced to calculating the dominant eigenvalue of the reactor characteristic matrix. Reference is finally made both to the calculation of k_{eff} dealt with in the perturbation theory and in the theory of coupled reactors and to the correlation between experimental and theoretical results. (auth)

16413 HW-61236(Suppl. 1)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
PLUTONIUM RECYCLE TEST REACTOR FINAL SAFEGUARDS ANALYSIS. SUPPLEMENT 1. ADDITIONAL STUDIES. N. G. Wittenbrock, ed. Apr. 15, 1960. 38p. Contract AT(45-1)-1350. OTS.

A supplement to the PRTR Final Safeguards, HW-61236, containing information and recommendations resulting from a review of PRTR by Advisory Committee on Reactor Safeguards is presented. Two revisions to operating limits cited in HW-61236 resulting from further design studies are also included. (J.R.D.)

16414 WCAP-1414

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
MULTI-REGION REACTOR LATTICE STUDIES. Quarterly Progress Report [for] January 1 to March 31, 1960. Ira H. Coen. Apr. 29, 1960. 37p. Contract AT(30-1)-2176. OTS.

The Multi-region Reactor Lattice Studies Program is an experimental and analytical program centered around a series of critical experiments to be performed at the Westinghouse Reactor Evaluation Center. These experiments will utilize stainless steel clad UO_2 fuel rods of three different enrichments and will be carried out at two moderating ratios. The planning and analysis of criticality experiments are discussed in some detail. Brief summaries are given for the work in hazard summary for the experiments, fabrication of fuel elements and control rods, performance of critical experiments, and CRX equipment. (For preceding period see WCAP-1408.) (W.D.M.)

16415

A CORRECTION TO THE EFFECTIVE RESONANCE INTEGRAL IN HETEROGENEOUS NUCLEAR REACTORS TO ALLOW FOR FUEL GEOMETRY. M. H. McKay and A. Keane (New South Wales Univ., Kensington). Australian J. Appl. Sci. 11, 1-15(1960) Mar.

The effective resonance integral for heterogeneous lattices as postulated by Wigner et al. (1955) consists of a "volume-absorption" term and a "surface-absorption" term. The former is independent of the geometry of the fuel elements, but the latter is a function of their surface-to-mass ratio. Approximations to the collision probability within the fuel elements made by Wigner, Chernick, and others simplified the calculation of the effective resonance integral, reducing it to the equivalent of the homogeneous case, but these approximations lead to considerable inaccuracy in the surface-absorption term and its relation to the geometry of the fuel elements. The method of Gurevich and Pomeranchouk is applied to evaluate the surface term of Wigner's effective resonance integral without making the above approximations, thus giving much more accurately its dependence on the surface-to-mass ratio of the fuel elements. Comparisons are made with the results obtained by using the former approximations, and the application of a correction factor in the evaluation of the effective resonance integral is suggested. This correction factor is calculated and tabulated for uranium and thorium fuel elements of various shapes and sizes and a graph is given from which the appropriate correction factor for other fuels may be evaluated. (auth)

16416

THE EFFECTS OF A CYLINDER-SHAPED CHANNEL ON NEUTRON DIFFUSION. N. I. Laletin. Kernenergie 3, 360-6(1960) Apr. (In German)

The voids in the active zone of a reactor have a marked influence on the neutron loss. This effect is very important in calculation of the critical mass of a reactor. Often it is of interest to know the effect of empty channels on the diffusion of neutrons beyond the active zone. A mathematical treatment of the effect of a hollow cylindrical channel on neutron diffusion is given. Expressions are obtained for the neutron loss through a channel at the center of a reactor and the additional loss in the region of the channel. A study is also made of the applicability of the diffusion equations to the distribution function of neutron flux along a channel. (tr-auth)

16417

DETERMINATION OF CRITICAL MASS AND NEUTRON FLUX DISTRIBUTION BY THE METHOD OF PHYSICAL MODELS. V. A. Dmitrievskii (Dmitrievskij) and I. S. Grigor'ev. Kernenergie 3, 366-70(1960) Apr. (In German)

The design of nuclear reactors, especially of new types, takes place before the experimental studies are made to determine their parameters. A new method for prior determination of critical mass and neutron flux distribution is discussed, a method using physical models. A reactor model is used for the experiments which contains no fissionable material. The "working" channels of the models are filled with a neutron absorber which has the same neutron absorption cross section as fissionable material. A neutron source which is moved along the channel imitates the production of fast neutrons. The distribution of the thermal neutron flux is measured with a detector which responds to thermal neutrons. If the power of the source and the absolute value of neutron flux are known, then one can obtain the critical mass from the experiment. The model method has been checked on a UF_6 reactor. The experimentally produced value for critical

mass was in good agreement with that obtained at startup. In addition to critical and exponential experiments for study of a proposed reactor, the method is also useful in the selection of optimal lattice parameters, and other factors. The method is very simple and requires neither fissionable material nor a high neutron flux. (tr-auth)

16418

ON THE VALIDITY OF THE SECOND FUNDAMENTAL THEOREM IN A MEDIUM WITH ANISOTROPIC SCATTERING. Lawrence Dresner (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 7, 419-24(1960) May.

The second fundamental theorem of reactor theory states that a good estimate of the nonleakage probability from a bare reactor is given by the Fourier transform of the infinite medium kernel evaluated at the asymptotic buckling of the reactor. Inönü has investigated the validity of this theorem for the one-velocity slab reactor with isotropic scattering by means of a variational technique. He finds its use gives very good results even for quite small reactors with dimensions of the order of a few mean free paths. In the present paper the effect of anisotropy in the scattering on the validity of the theorem is investigated by a variation-iteration technique. It is concluded that the theorem is, in general, less reliable the more anisotropic the scattering. (auth)

16419

A SIMPLIFIED THEORY OF PILE NOISE. Charles Erwin Cohn (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 7, 472-5(1960) May.

A theoretical treatment is given of the statistical fluctuations in neutron population which occur in nuclear reactors. The absolute magnitude and frequency dependence of the spectral density of these fluctuations is obtained. The model used assumes that the fluctuations arise from a "noise-equivalent source" whose strength can be easily calculated from fundamental considerations. Calculations are also presented of the fundamental statistical errors in criticality measurements. (auth)

16420

VOID COEFFICIENT MEASUREMENT. Frederick J. Shon and Charles Zucker (Univ. of California, Livermore and Fairleigh Dickinson Univ., Teaneck, N. J.). Nuclear Sci. and Eng. 7, 478(1960) May.

A method is presented for measuring void coefficient in tank-type reactors with plate spacing of the order of $\frac{1}{8}$ in. (W.L.H.)

16421

RELIABILITY OF REACTOR COINCIDENCE SAFETY SYSTEMS. Tadeusz Owczarski (Warsaw Electrical Inst.). Nukleonika 4, 655-63(1959). (In Polish)

The analysis, employing elementary statistical methods, of reactor coincidence safety systems is presented. Practical conclusions are included. (auth)

16422

METALS FOR NUCLEAR REACTORS. W. A. Maxwell, ed. Cleveland, American Society for Metals, 1959. 123p.

A treatment of reactor metallurgy on a broad basis is presented in order to provide an introduction to this new field. The book is divided into chapters dealing with the physical principles of metals and reactors, typical problems in reactors which metals must solve, effects of radiation (fast neutrons and gamma) on metals, corrosion by liquid metals and aqueous solutions, and testing methods. (D.L.C.)

16423

BASIC PRINCIPLES OF NUCLEAR SCIENCE AND REACTORS. Alan M. Jacobs, Donald E. Kline, and Forrest J. Remick. Van Nostrand Nuclear Science Series. New York, D. Van Nostrand Company, Inc., 1960. 270p. $6.50.

The basic theory of fission chain reactors is qualitatively developed and applied in an analysis of existing systems. The mathematics used requires only a knowledge of calculus. The book is considered primarily as a text for upper-class undergraduate engineers or scientists in a course designed to be an introduction to the general fields covered. Included are discussions of elements and nuclear particles, binding energy and radioactivity, nuclear interactions and cross sections, fission processes, neutron-induced fission chain reactions, multiplication and criticality factors, temporal characteristics of reactors, reactor systems, gamma interactions, shielding, health protection, and uses of radiation. The end result is a clear introductory to the design and use of nuclear reactors and radioisotopes. (B.O.G.)

16424

International Atomic Energy Agency, Vienna. HEAVY WATER LATTICES. 1960. 142p. $1.50.

Reactor physicists from Chalk River, Saclay, Kjeller, Harwell, Savannah River, A.B. Atomenergi, and Argonne attended the panel meeting on the Physics of Heavy Water Lattices. The research programs of the various laboratories were discussed and the existing data were compared and evaluated. A series of 14 technical papers is presented in the appendix; they cover practical aspects of heavy water reactor lattices such as operating experience with the NRU, definitions of lattice parameters, lattice buckling, resonance escape probability, and reactor spectra. (D.L.C.)

16425

IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Alan Robert Kirkpatrick (to C. A. Parsons & Co., Ltd.). British Patent 835,257. May 18, 1960.

A control rod design is offered. Tabular inserts of sintered boron–stainless steel powder are put in a stainless steel sheath, and a stainless steel tube is inserted into the sintered tubes. The whole is then welded. Exact dimensions are possible with this type of construction. (T.R.H.)

16426

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Derek Randall Smith, Alan Frederick Edward Wise, and Geoffrey John Bealey (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 835,326. May 18, 1960.

A finned fuel element is described. It has longitudinal fins on a round rod, with helically arranged turbulators. (T.R.H.)

16427

NEUTRONIC REACTORS. J. B. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 2,920,025. Jan. 5, 1960.

A reactor is described which comprises a tank, a plurality of coaxial steel sleeves in the tank, a mass of water in the tank, and wire grids in abutting relationship within a plurality of elongated parallel channels within the steel sleeves, the wire being provided with a plurality of bends in the same plane forming adjacent parallel sections between bends, and the sections of adjacent grids being normally disposed relative to each other.

16428

THERMAL NEUTRONIC REACTOR. B. I. Spinrad (to U. S. Atomic Energy Commission). U. S. Patent 2,921,007. Jan. 12, 1960.

A novel thermal reactor was designed in which a first reflector formed from a high atomic weight, nonmoderating material is disposed immediately adjacent to the reactor

core. A second reflector composed of a moderating material is disposed outwardly of the first reflector. The advantage of this novel reflector arrangement is that the first reflector provides a high slow neutron flux in the second reflector, where irradiation experiments may be conducted with a small effect on reactor reactivity.

16429

NEUTRONIC REACTOR WITH ACCESSIBLE THIMBLE AND EMERGENCY COOLING FEATURES. W. H. McCorkle (to U. S. Atomic Energy Commission). U. S. Patent 2,926,127. Feb. 23, 1960.

A safety system for a water-moderated reactor is described. The invention comprises a reservoir system for spraying the fuel elements within a fuel assembly with coolant and keeping them in a continuous bath even if the coolant moderator is lost from the reactor vessel. A reservoir gravity feeds one or more nozzels positioned within each fuel assembly which continually forces water past the fuel elements.

16430

NEUTRONIC REACTOR CONSTRUCTION AND OPERATION. J. M. West and J. T. Weills (to U. S. Atomic Energy Commission). U. S. Patent 2,928,779. Mar. 15, 1960.

A method is given for operating a nuclear reactor having a negative coefficient of ractivity to compensate for the change in reactor reactivity due to the burn-up of the xenon peak following start-up of the reactor. When it is desired to start up the reactor within less than 72 hours after shutdown, the temperature of the reactor is lowered prior to start-up, and then gradually raised after start-up.

16431

A COOLED NEUTRONIC REACTOR. E. P. Wigner and E. C. Creutz (to U. S. Atomic Energy Commission). U. S. Patent 2,928,781. Mar. 15, 1960.

A nuclear reactor comprising a pair of graphite blocks separated by an air gap is described. Each of the blocks contains a plurality of channels extending from the gap through the block with a plurality of fuel elements being located in the channels. Means are provided for introducing air into the gap between the graphite blocks and for exhausting the air from the ends of the channels opposite the gap.

16432

NUCLEAR REACTOR CORE DESIGN. J. E. Mahlmeister, W. S. Peck, W. V. Haberer, and A. C. Williams (to U. S. Atomic Energy Commission). U. S. Patent 2,929,768. Mar. 22, 1960.

An improved core design for a sodium-cooled, graphite-moderated nuclear reactor is described. The improved reactor core comprises a number of blocks of moderator material, each block being in the shape of a regular prism. A number of channels, extending the length of each block, are disposed around the periphery. When several blocks are placed in contact to form the reactor core, the channels in adjacent blocks correspond with each other to form closed conduits extending the length of the core. Fuel element clusters are disposed in these closed conduits, and liquid coolant is forced through the annulus between the fuel cluster and the inner surface of the conduit. In a preferred embodiment of the invention, the moderator blocks are in the form of hexagonal prisms with longitudinal channels cut into the corners of the hexagon. The main advantage of an "edge-loaded" moderator block is that fewer thermal neutrons are absorbed by the moderator cladding, as compared with a conventional centrally loaded moderator block.

Power Reactors

16433 APAE-40(Vol.I)

Alco Products, Inc., Schenectady, N. Y.

PRELIMINARY DESIGN STUDY OF APPR-1B PWR-STEAM ELECTRIC STATION. VOLUME I. PRELIMINARY DESIGN STUDY OF STEAM-ELECTRIC CONVERSION SYSTEM. Dec. 11, 1958. 141p. Contract DA-44-009-ENG-3506.

A portion of the work presented in this report was performed by Bechtel Corp., San Francisco.

The preliminary design of the SM-2 secondary system (power conversion equipment) is reported. Parameters, equipment, building, services, estimated cost, reliability, and a point of departure in meeting the required "quality of power" are discussed. (W.D.M.)

16434 APAE-40(Vol.II)

Alco Products, Inc., Schenectady, N. Y.

PRELIMINARY DESIGN STUDY OF SM-2 (APPR-1B) PWR-STEAM ELECTRIC STATION. VOLUME II. PRELIMINARY DESIGN STUDY OF REACTOR SYSTEM AND AUXILIARIES. June 5, 1959. 251p. Contract DA-44-009-ENG-3506.

A portion of the work presented in this report was performed by Bechtel Corp., San Francisco.

Results are presented on the preliminary design study of the SM-2 reactor system and auxiliaries. The equipment, building, services, and estimated cost are defined. All efforts were made to produce a primary system design which meets the transient response requirements and the high reliability requirements. (W.D.M.)

16435 APAE-56

Alco Products, Inc., Schenectady, N. Y.

WASTE DISPOSAL CONSIDERATIONS FOR THE SM-2 DESIGN. J. L. Zegger. May 13, 1960. 81p. Contract DA-44-192-ENG-7.

An evaluation of SM-2 waste disposal was made with particular emphasis on decontamination wastes. Waste volume and activity were estimated and three possible waste disposal systems were considered. Two systems, evaporation and ion exchange, were compared on the basis of flexibility in a remote location, operational problems, and cost. The former was recommended for the SM-2. (auth)

16436 APAE-60

Alco Products, Inc., Schenectady, N. Y.

SM-2 PREASSEMBLY AND PACKAGING STUDY. M. A. Hamulak. May 6, 1960. 138p. Contract DA-44-192-ENG-7.

A study of preassembly and packaging of SM-2 plant equipment was undertaken to develop an SM-2 final design with minimum field erection, reduction in over-all construction costs, and provisions for dismantling equipment after a period of operation. Equipment sizes are based on utilization of a 28 Mw(th) pressurized water reactor and a 7500 kw turbo-generator. Drawings showing the arrangement of equipment on skids and the over-all plant layout are provided. Studies and surveys for primary shielding are included, as are equipment evaluations and a cost evaluation of a packaged plant versus a field erected plant. (auth)

16437 APAE-Memo-231

Alco Products, Inc., Schenectady, N. Y.

SM-2—HORIZONTAL STEAM GENERATOR ANALYSIS. H. F. Van Kessel. Nov. 1, 1959. 130p. Contract DA-44-192-ENG-7. (AD-228692)

A horizontal steam generator design for the SM-2 was subjected to a theoretical analysis to determine the per-

formance of such a steam generator under steady state operating conditions and during load transients. The configuration for this design is a two-drum unit consisting of a heat exchanger unit and separator drum interconnected by integral riser and downcomer. An analog computer was used to analyze the steam generator behavior during load transients. The effect of various design changes on the response of the steam generator to step changes in load was determined. The horizontal steam generator design was compared to the existing vertical steam generator design for weight, size, price, and performance. (auth)

16438 BAW-1153-1

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

NUCLEAR MERCHANT SHIP REACTOR PROJECT; SURVEY OF THE REACTOR AND CONTROL DRIVE SYSTEM RESEARCH AND DEVELOPMENT PROGRAM. Don M. Bylund, comp. Aug. 1959. 287p. Contract AT(30-3)-274. OTS.

The results of a program to confirm the design of the reactor and control rod drive system for the NS Savannah Power Plant are given. Three principal groups of tests are covered: non-irradiation testing, irradiation testing, and control rod driveline testing. (W.D.M.)

16439 CF-60-1-107

Oak Ridge National Lab., Tenn.

STATISTICAL ANALYSIS OF SMALL POWER OSCILLATIONS IN THE HRT. J. Hirota. Jan. 29, 1960. 31p. OTS.

Small oscillations in power level were intensively studied in the HRT Run 20. The amplitude distributions of small oscillations provided the quantitative measurement of "roughness" of reactor power. By using autocorrelation techniques, the resonance behavior of small oscillations was found. So far as small changes are concerned, the transfer function of the HRT was calculated, taking gas effects into account. Comparing the calculated transfer functions with the Fourier amplitude of measured power deviations indicated that the reactor core probably contains gas. The distortions of power spectrum due to the fuel instability were also investigated. The analysis of small oscillations gave some insight into the fuel instability mechanism occurring in the HRT. (auth)

16440 CF-60-5-50

Oak Ridge National Lab., Tenn.

ANALOG COMPUTER STUDY OF THE MSR-ORR IN-PILE PRESSURIZED WATER LOOP NO. 1. S. J. Ball. May 6, 1960. 12p. OTS.

A study of the dynamic behavior of the Merchant Ship Reactor Pressurized Water Loop was made using the Reactor Controls Analog Facility. Computer curves show the predicted response of the loop temperatures to normal load changes and component failure accidents. Except for complete flow stoppage, which was not investigated here, the safety system was shown to be adequate in curbing loop temperature excursions due to postulated accidents. (auth)

16441 CF-60-5-93

Oak Ridge National Lab., Tenn.

EVALUATION OF EXTERNAL HOLDUP OF CIRCULATING FUEL THERMAL BREEDERS AS RELATED TO COST AND FEASIBILITY. I. Spiewak and L. F. Parsly. May 12, 1960. 52p. OTS.

The external holdup of expensive materials and associated capital costs for the heat removal systems of fluid fuel breeders were determined. The aqueous homogeneous and molten salt breeders were found to contain substantially less uranium holdup external to the core than the liquid metal fueled breeder. The cost of heat removal and turbogenerator plant equipment for the three systems was compared. (auth)

16442 DP-475

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.

HEAVY WATER MODERATED POWER REACTORS. Progress Report for February 1960. R. R. Hood and L. Isakoff, comp. Apr. 1960. 39p. Contract AT(07-2)-1. OTS.

At the end of February 1960, 30% of the construction of the Heavy Water Components Test Reactor (HWCTR) was complete. Limits for safe operation of the reactor were defined, and the general procedures for startup, shutdown, and normal operation were formulated. A detailed analysis of operating stresses in the reactor vessel defined the maximum rates of heating and cooling that can be tolerated. Core swelling produced a maximum cladding strain of 0.7% in a Zircaloy-2-clad tube of U–2 wt.% Zr that was irradiated to an average burnup of 1100 Mwd/t in the VBWR. (For preceding period see DP-465.) (auth)

16443 GNEC-118

Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.

NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. First Quarterly Progress Report for July–September 1959. 70p. Contract AT(11-1)-795. OTS.

The research and development program by CE-GNEC will cover work aimed at establishing the technological and economic feasibility of producing superheated steam from a boiling water reactor. The following broad categories of design, engineering, research, and development are discussed. Development of preliminary reference design criteria for a 200-Mw(e) boiling-superheating reactor which produces steam at 1050°F and 1200 psig; theoretical and experimental studies on the peculiar nuclear problems in a boiling-superheating reactor; steam-water separators for the superheating region; development of final reference design criteria for a 200-Mw(e) reactor; and development work on specific problems pertaining to the 17.3-Mw(e) Boiling Nuclear Superheater Reactor (BONUS) being designed for the Puerto Rico Water Resources Authority. Work on BONUS includes structural restraint of fuel elements, heat transfer tests simulating loss of steam coolant, insulation and seal connector development, and control development. (W.D.M.)

16444 GNEC-125

Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.

NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Second Quarterly Progress Report for October–December 1959. 99p. Contract AT(11-1)-795. OTS.

Studies of various boiler-superheater core configurations and of fuel elements and control methods were carried out. The most attractive concept appeared to be one in which a central boiler region is surrounded by an annular region in which both boiling and superheating occur. Outlet steam conditions are 1200 psig and 1050°F. Other core configurations and fuel elements are being considered. Heat transfer studies indicated that the tendency of combination boiler-superheater fuel elements to transfer a smaller fraction of heat to the steam as the total power output decreases was reduced considerably by the use of a double-annular boiler-superheater element. Preliminary results of reactor physics analyses are reported. The CEND critical facility was modified for performance of critical experiments on boiler-superheater core lattices. It was

decided to proceed to large-scale high-pressure tests of steam-water separators after a minimum of preliminary small-scale experiments at low pressure. Materials and components are being procured for the experiments on the 17.3-Mw(e) BONUS Reactor. (W.D.M.)

16445 HW-59786

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRTR FUEL ELEMENT NUCLEAR SAFETY. N. Ketzlach. Mar. 30, 1959. 5p. Contract AT(45-1)-1350. OTS.

Nuclear safety criteria are reviewed for the storage and transportation of fuel elements for the PRTR, both for immersion in air and water. The criteria are presented in the form of tables for spacing and safe number of clusters. Four storage systems and their critical parameters are discussed: New Fuel Storage Pit (H-3-11078), Fuel Transfer Storage Pit (H-3-11097), Storage Basin (HW-3-11030), and a lead shielded fuel transfer cask (unnumbered). (D.L.C.)

16446 KAPL-M-WMC-3

Knolls Atomic Power Lab., Schenectady, N. Y.

TRIP REPORT: U.S.-U.K. FAST REACTOR MEETING, ANL, APRIL 30 TO MAY 3, 1956. W. M. Cashin and J. K. Davidson. [1956]. Decl. May 5, 1960. 15p. Contract W-31-109-Eng-52. OTS.

Fast reactors are discussed, with particular reference to the EBR-I and -II. A brief summary of the KAPL fast oxide breeder program is presented. (C.J.G.)

16447 LAMS-2386

Los Alamos Scientific Lab., N. Mex.

DESIGN CONSIDERATIONS FOR A PLASMA THERMOCOUPLE REACTOR. Bob E. Watt. Jan. 15, 1960. 24p. Contract W-7405-eng-36. OTS.

General features of a nuclear reactor–plasma thermocouple power system are investigated. Only simple plasma cells are considered, for which all the experimental data and most of the theory were presented elsewhere. From the available information it is concluded that the reactor should be a heterogeneous system alternating hot junctions (reactor fuel) and cold junctions (liquid metal coolant preferred) and must contain a large number of cells. Uncertainties in many of the important parameters and in the design concepts leave the conclusions open to debate and emphasize the need for more experimental and theoretical work. (auth)

16448 LAMS-2423

Los Alamos Scientific Lab., N. Mex.

QUARTERLY STATUS REPORT OF THE LASL PLASMA THERMOCOUPLE DEVELOPMENT PROGRAM FOR PERIOD ENDING MARCH 20, 1960. Samuel Glasstone, comp. and ed. Apr. 1960. 18p. Contract W-7405-eng-36. OTS.

By improvement in the temperature control of the oil bath, it was found possible to operate the plasma thermocouple cells at temperatures down to 22°C, corresponding to a cesium vapor pressure of 10^{-6} mm Hg where collisions of electrons and ions with neutral atoms are negligible. As a result it was possible to measure ion currents, as well as short circuit currents and open circuit voltages, for a pressure range of 10^{-6} to 1 mm Hg. In order to obtain some understanding of the nature of plasma cell oscillations, observations were made of voltage and current wave forms generated by a cell with a Ta emitter. Oscillations were obtained for cesium pressures varying from 3×10^{-6} to 10^{-2} mm Hg and for a wide range of emitter temperature. The effect on the oscillations of varying the operating voltage of the cell and of the emitter-collecter separation distance was observed. The possibility of designing a plasma thermocouple reactor to operate as a power supply in space vehicles was given consideration. In-pile testing, plasma cell design, structural changes in fuel elements, spectroscope examination of a plasma cell, cesium vapor equilibrium, thermionic emission studies and data reduction, fabrication techniques, and properties of materials are summarized. (For preceding period see LAMS-2396.) (W.D.M.)

16449 NAA-SR-4066

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A SUMMARY OF NUCLEAR CALCULATIONS FOR THE ORGANIC MODERATED REACTOR EXPERIMENT (OMRE). R. O. Williams, Jr. and R. F. Wilson. May 15, 1960. 84p. Contract AT-11-1-GEN-8. OTS.

The geometric, material, and nuclear constants, together with their application, used in predicting the nuclear behavior of the OMRE, are summarized. The OMRE is a diphenyl moderated and cooled thermal reactor utilizing fully enriched uranium oxide as fuel. (W.D.M.)

16450 NAA-SR-4385

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

HYDRAULIC CHARACTERISTICS OF HNPF PRELIMINARY DESIGN FUEL ELEMENTS. S. Sudar and D. Rosh. May 15, 1960. 31p. Contract AT-11-1-GEN-8. OTS.

Pressure-drop measurements were obtained for the fuel element assemblies proposed for the Hallam Nuclear Power Facility (HNPF) using water as the test fluid. Two fuel element assemblies were tested, both being of a multiple-rod type as follows: (1) a 43-rod brazed ferrule assembly, and (2) a 19-rod mechanically spaced assembly. The experimental results agreed satisfactorily with pressure-drop determinations obtained by application of the Darcy equations utilizing the equivalent diameter as a correlation parameter and standard round-pipe friction factors. The experimental friction factors agreed within ±20% with standard smooth-pipe data over the Reynolds number range of 20,000 to 150,000. The water test data were generalized for design application to the sodium coolant system. (auth)

16451 NAA-SR-Memo-45

North American Aviation, Inc., Downey, Calif.

HETEROGENEOUS, LIQUID FUEL, BERYLLIUM MODERATED REACTOR. N. Neustadt. July 25, 1951. Decl. Mar. 2, 1960. 31p. OTS.

Criticality calculations were made for a heterogeneous reactor containing a beryllium moderator. The fuel is U^{235} dissolved or otherwise dispersed in bismuth or lead. The Bi–U or Pb–U alloy is enclosed in a Mo tube. The Mo tube is surrounded by a gap of volume equal to the volume of the fuel rod. This gap is to be filled with He to insulate the moderator from the fuel rods. The temperatures considered are 1947 and 20°C. The liquid metal is at 1947°C and the moderator is at 20°C. The ratio of m_{Be}/m_{25} is used (neutrons cold, or E = 0.025 e.v.). The Mo tube wall thicknesses considered are $1/32$ and $1/16$ inch. (auth)

16452 NAA-SR-Memo-4455

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PRELIMINARY FUEL BURNUP STUDY OF THE 255 MWE ASGR. A. L. Aronson. Oct. 6, 1959. 14p. OTS.

Studies were made to determine the effects of fuel burnup on reactivity, power distribution, and isotopic fuel composition. Starting with an initial value of $K_{eff} = 1.139$, hot,

clean, the core will go subcritical at an average core exposure of 700 Mwd/t. Equilibrium Xe and Sm account for a sharp initial decrease in reactivity of $\Delta k_{eff} = -0.031$, and the remainder is due to fuel burnup. As burnup proceeds the ratio of the radial peak to average power decreases from an initial value of 1.46 to a value of 1.24 at 7,000 Mwd/t. At 7,000 Mwd/t 91.4 kg of U^{235} out of an initial 397.0 kg were consumed in fission, and 23.8 kg were converted to U^{236}. A total of 84.8 kg of Pu was produced from U^{238}, of which 34.3 kg were consumed in fission and 50.5 kg remain in the fuel. (W.L.H.)

16453 NAA-SR-Memo-4626

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMAL-HYDRAULIC ANALYSIS OF THE PIQUA CORE. J. D. Wilde. Nov. 13, 1959. 25p. OTS.

An investigation of the Piqua core was conducted to determine hot channel factors, flow rates for each fuel element, fuel element maximum surface temperatures, and the potential maximum power of the reactor when the fuel elements are orificed for an outlet temperature of 575° and are limited by a maximum surface temperature of 750°F. Results are presented and analyzed. (J.R.D.)

16454 NAA-SR-Memo-4790

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

PIQUA OMR HIGH BOILER DISPOSAL PROTOTYPE: SYSTEM DESCRIPTION AND OPERATING EXPERIENCE. R. R. Stiens. Feb. 1, 1960. 19p. OTS.

Process information required for the design and operation of the Piqua High Boiler Disposal System was obtained. The process system constructed at the Organic Laboratory in Burro Flats is described, and operating experience to date is summarized. (W.D.M.)

16455 NAA-SR-Memo-5059

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

RELATIONSHIP OF RADIATION UNITS TO RADIATION DAMAGE FOR SNAP 2 REACTOR SYSTEMS. F. D. Anderson. Mar. 9, 1960. 13p. OTS.

The various radiation units that are used to describe the radiation damage observed in materials from specific radiation sources are defined. Conversion constants for converting known radiation source strengths to observed radiation damage results are given. The different radiation source strengths expected from an unshielded SNAP-2 reactor system are related. (W.D.M.)

16456 NAA-SR-Memo-5103

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EXPERIMENTAL SHIELDING EVALUATION OF THE SETF USING SDR-I AND SNAP 10 AS RADIATION SOURCES. R. L. Tomlinson. Mar. 29, 1960. 26p. OTS.

The SNAP Environmental Test Facility was designed for the full-power testing of unshielded SNAP reactors in an environment that will approach that of satellite conditions. An evaluation is made of those features concerned with nuclear radiation and shielding as they affect the operation of the SETF. Items to be evaluated and techniques available to perform and analyze the required measurements are discussed. (W.D.M.)

16457 ORNL-1947(Del.)

Oak Ridge National Lab., Tenn.

AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 10, 1955. A. W. Savolainen, ed. Nov. 10, 1955. Decl. with del. Oct. 22, 1959. 175p. Contract W-7405-eng-26. OTS.

The technical progress of the research on circulating fuel reactors and other ANP research at ORNL is summarized. The design, construction, and operation of the 60-Mw Aircraft Reactor Test (ART) are the specific objectives of the project. Operation of the system will be for the purpose of determining the feasibility, and the problems associated with the design, construction, and operation, of a high-power, circulating-fuel, reflector-moderated aircraft reactor system. Areas covered include reflector-moderated reactor, experimental reactor engineering, critical experiments, chemistry of reactor materials, corrosion research, metallurgy and ceramics, heat transfer and physical properties, radiation damage, analytical chemistry of reactor materials, and recovery and reprocessing of reactor fuels. (For preceding period see ORNL-1896.) (W.D.M.)

16458 PRDC-TR-30

Power Reactor Development Co., Detroit.

MONTHLY TECHNICAL REPORT [FOR] DECEMBER 1959. 38p. Contract AT(11-1)-476. OTS.

Research and development activities on the Fermi Fast Breeder Reactor are briefly summarized in terms of core design, materials, nuclear engineering, instrumentation, liquid metal and steam systems, test operations, and environs monitoring. (For preceding period see PRDC-TR-29.) (W.D.M.)

16459 TID-5852

Duquesne Light Co., Shippingport, Penna.

CORE I CONTROL ROD DRIVE MECHANISMS PERIODIC TESTS. SECTION I. ELEVENTH PERFORMANCE. Test Results DL-S-148 (T-550011). First issue, Mar. 22, 1960. 14p. OTS.

The performance of the Shippingport Pressurized Water Reactor control rod drive mechanisms was determined. The operating characteristics of the rod drive mechanisms did not change appreciably compared to previous test results. (C.J.G.)

16460 TID-5853

Duquesne Light Co., Shippingport, Penna.

CORE INSTRUMENTATION CALIBRATION. SECTION V. SIXTH PERFORMANCE. Test Results DL-S-162. First issue, Mar. 22, 1960. 17p. OTS.

The calibration of the thermocouples used to measure the blanket exit and inlet water temperature and the seed exit water temperatures at constant blanket and seed flows in the Shippingport Pressurized Water Reactor is described. (C.J.G.)

16461 TID-5854

Duquesne Light Co., Shippingport, Penna.

PERIODIC RADIATION SURVEY OF REACTOR PLANT CONTAINERS AND COMPONENTS AFTER SHUTDOWN. SECTION III. "D" SURVEY, FIRST PERFORMANCE. CORE 1, SEED 1. Test Results DL-S-184 (T-612076). [Mar. 1960]. 7p. OTS.

Tests were performed to determine the effectiveness of flushing and draining for removing contamination from the 1BD Purification System hairpin loop of the Shippingport Pressurized Water Reactor. Measurements were made of the rate of radioactive decay of the remaining contamination. (C.J.G.)

16462 TID-5855

Duquesne Light Co., Shippingport, Penna.

RADIATION SURVEY OF REACTOR PLANT CONTAINERS

AND COMPONENTS AFTER SHUTDOWN "D" SURVEY. SECTION III. SECOND PERFORMANCE. CORE 1, SEED 1. Test Results DL-S-184 (T-612076). Second issue, Mar. 22, 1960. 8p. OTS.

Tests were performed to determine the amount of radioactive material build-up in the horizontal and vertical legs of the 1AC hairpin loop of the Shippingport Pressurized Water Reactor. The time required for this radiation level to decrease to a steady state value was determined. (C.J.G.)

16463 TID-5856

Duquesne Light Co., Shippingport, Penna.

PERIODIC RADIATION SURVEY OF REACTOR PLANT CONTAINER AND COMPONENTS AFTER SHUTDOWN "G" SURVEY. SECTION V. EFPH—4235.5. CORE 1, SEED 1. Test Results DL-S-184 (T-612076). [Mar. 1960]. 13p. OTS.

The radiation level and its decay at expected hot spots in the reactor container and the pressurizer cubicle of the Shippingport Pressurized Water Reactor were measured. (C.J.G.)

16464 TID-5857

Duquesne Light Co., Shippingport, Penna.

COMPARISON OF FEDAL MONITOR READINGS WITH RADIOCHEMICAL SAMPLE DATA. SECTION I. THIRD PERFORMANCE. CORE 1, SEED 1. Test Results DL-S-229 (T-641305). First issue, Mar. 25, 1960. 19p. OTS.

The determination of specific isotopic fission product activities in the primary cooling water of the Shippingport Pressurized Water Reactor by the FEDAL monitoring system and by radiochemical sampling was compared. (C.J.G.)

16465 TID-5858

Duquesne Light Co., Shippingport, Penna.

PERIODIC RADIATION SURVEY. SECTION II. 5187.7 EFPH. THIRD PERFORMANCE. CORE I, SEED 1. Test Results DL-S-231 (T-612394). First issue, Apr. 4, 1960. 16p. OTS.

The radiation level in the turbine service building, around the fuel handling canal, and the limited access areas of the reactor plant containers was determined at 5187.7 EFPH during operation of the Shippingport Pressurized Water Reactor. (C.J.G.)

16466 TID-5859

Duquesne Light Co., Shippingport, Penna.

CALIBRATION OF CORE THERMOCOUPLES FOR 0-300 F SERVICE. SECTION I. CORE I, SEED 1. Test Results DL-S-268-S (RNI-18). [Mar. 1960]. 11p. OTS.

The calibration and performance of the core exit water thermocouples and biasing equipment for recorder readings in the 0 to 300°F range of the Shippingport Pressurized Water Reactor are described and discussed. (C.J.G.)

16467 TID-5860

Duquesne Light Co., Shippingport, Penna.

NUCLEAR INSTRUMENTATION—DETERMINING SOURCE OF SPIKES IN NUCLEAR INSTRUMENTS. SECTION I. Test Results DL-S-280-S (RNI-10A). Second issue, Apr. 8, 1960. 4p. OTS.

The power and temperature control system of the Shippingport Pressurized Water Reactor was investigated to determine the source of the "spikes" which initiate spurious rod motion. It was found that the circuit design of the intermediate range log microammeter is not the source of the "spikes." (C.J.G.)

16468 TID-6032

Atomic Power Development Associates, Inc., Detroit.

SURVEY OF THE RADIATION LEVELS IN THE CONTAINMENT VESSEL OF THE ENRICO FERMI ATOMIC POWER PLANT. PART V. GAMMA RADIATION LEVELS ON THE OPERATING FLOOR OF THE CONTAINMENT BUILDING. a. LEVELS ABOVE THE EQUIPMENT COMPARTMENT. Technical Memorandum No. 16. W. F. Chaltron and H. E. Hungerford. [Dec. 22, 1959]. 47p. Contract AT(11-1)-476. OTS.

The results are presented of a survey of calculated gamma-ray levels at many points on the surface of the operating floor of the containment building for the Enrico Fermi reactor. That portion of the floor surveyed lies directly above the equipment compartment. The calculations were made with the aid of an IBM-650 electronic computer. The main source of radioactivity which gives rise to gamma radiation above the floor is the radioactive sodium-24 in the primary coolant system. This system was considered to be completely filled with sodium, and activated to an equilibrium activity of 0.05 curies/cc, which corresponds to infinite reactor operation at 500 megawatts power. No fission product contamination was considered for these calculations. The operating floor is 5 feet thick and of concrete and steel. The results of the survey indicate that above the equipment compartment the surface dose on the operating floor will in no case exceed 0.9 mr/hr at the expected full operating power of 430 megawatts. Included as appendices are derivations and methods of corrections from one set of concrete and steel thicknesses to another. (auth)

16469 TID-8517(Pt. II)

Atomic Energy Commission, Washington, D. C.

CIVILIAN POWER REACTOR PROGRAM. PART II. ECONOMIC POTENTIAL AND DEVELOPMENT PROGRAM AS OF 1959. 1960. 100p. GPO.

The status of technology of nuclear power reactors in 1959 is reviewed. General research and engineering development activities are discussed. The reactors considered include the pressurized water, boiling water, light water moderated superheat, organic cooled, sodium graphite, gas cooled enriched fuel, gas cooled natural uranium, fast breeder, aqueous homogeneous, and heavy water. Power costs are compared with the cost of power from conventional plants. (C.H.)

16470 YAEC-142

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

TWO-REGION CRITICAL EXPERIMENTS WITH WATER MODERATED SLIGHTLY ENRICHED UO_2 LATTICES. P. W. Davison, V. E. Grob, D. F. Hanlen, R. D. Leamer, H. Ritz, and E. Santandrea. Nov. 30, 1959. 85p. For Yankee Atomic Electric Co. Contract AT(30-3)-222. Subcontract No. 1. OTS.

As an extension of the Yankee and BR-3 Critical Experiments, a series of two-region critical experiments were performed at the Westinghouse Reactor Evaluation Center from the end of 1958 through the first half of 1959. The primary purpose of these experiments was to measure the spatial distribution of neutron flux and power production in reactor cores of simple geometric shape containing two regions of different fuel enrichments in order that a comparison could be made with analytically derived distributions for the same cores. Gold foils, U^{238} foils, and fuel rods were used to obtain thermal flux, fast flux, and power production through the cores. In addition, critical size, buckling, reflector savings, and microscopic parameter

measurements were made in single-region cores of 4.4% fuel in the two lattices used. (auth)

16471 YAEC-154

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

DESIGN OF THE YANKEE CORE I FUEL ASSEMBLY. A. G. Thorp, II. Jan. 1960. 67p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

The mechanical, thermal, and hydraulic design characteristics of the Yankee Core I fuel assembly were established in detail. The core is made up of 23,142 fuel rods of full core length (7.5 feet) arranged to form 76 fuel assemblies. The fuel assemblies are of two types, 38 of each type being required for the complete core. The fuel assembly design was based upon the use of stainless steel cladding and UO_2 fuel. The basic objective of minimizing poison material in the core was achieved by the means of utilizing the fuel clad as the basic structural element of the fuel assemblies. Brazed ferrules and welded straps were considered as alternatives for joining the fuel rods into sub-assemblies, the final choice being the brazed ferrule construction which provides better thermal, hydraulic, nuclear and mechanical characteristics. Tests were conducted to verify the hydraulic characteristics of the fuel assemblies. Good correlation was found between the basic hydraulic parameters and the pressure drop. Metallurgical, mechanical, and process development testing was conducted on the fuel rod. Material properties were established and suitable design and process techniques were evolved for the fuel rods. An extensive development program to perfect brazing techniques was conducted to braze the fuel rods into sub-assemblies. The successful results of this program permitted the use of the brazed ferrule feature in the structural design of the fuel assembly. Thermal bowing tests were conducted on a single sub-assembly in order to verify analytical techniques. The resultant verification permitted the development of a final design which can be relied upon not to bow excessively during reactor operation. Other less critical components of the assembly were also subjected to mechanical tests. (auth)

16472

PEBBLE BED NUCLEAR REACTORS FOR SPACE VEHICLE PROPULSION. Myron M. Levoy and John J. Newgard (Thiokol Chemical Corp., Denville, N. J.). Aero/Space Eng. 19, No. 4, 54-8(1960) Apr.

The propulsion requirements necessary to launch a payload of 20 to 150,000 lbs in a 300 nautical mile orbit are discussed in conjunction with pebble-bed reactors. The design parameters are given for a typical space vehicle utilizing this type reactor. The reactor core is a right cylinder composed of graphite spheres impregnated with uranium. The reflector thickness is six inches of random sized BeO pellets. The hydrogen propellant enters the core and reflector at −367°F and 400 psia; exits from the core at 4,200°F and 100 psia; and leaves the reflector at 1,500°F and 150 psia. Schematics are given for the rocket with the reactor, and for the reactor. Graphical representations of reactor and core parameters are included. (B.O.G.)

16473

UTILIZATION OF PLASMA-CELL ENERGY CONVERSION IN NUCLEAR REACTORS. William A. Ranken and Thurman G. Frank (Los Alamos Scientific Lab., N. Mex.). Aero/Space Eng. 19, No. 5, 58-9(1960) May.

The plasma cell is discussed in connection with its ability to directly convert heat to electricity. This fact shows considerable promise as a basis for the design of space nuclear-electric power supplies. The cell is capable of transforming thermal or fission energy into electrical energy without moving parts, giving highly reliable power supplies. Temperatures in excess of 2,600°K can be attained while the heat sink operates at 1,500°K. A high-temperature heat sink is desirable, since all outer space power stations must dump waste heat by radiation. Comparative current voltage characteristics for an emitter temperature of 2,540°K and a Cs pressure of 0.5 mm Hg are given. (B.O.G.)

16474

A CIRCULATING DUST-FUELED, RADIATION-COOLED SPACE POWER REACTOR. W. R. Corliss (Martin Co., Baltimore). Aero/Space Eng. 19, No. 5, 60-1(1960) May.

This concept is a fusion of two well known concepts, the Armour Dust-Fueled Reactor (ADFR) and the radiation-cooled reactor allied with a shell of direct conversion elements. The design summary of a 1 Mw(e) reactor of this type is given. The expected lifetime is 10,000 hrs with a converter efficiency of 10%. It is suggested that the fuel be in the form of UC_2 or PuC dust, thus replacing the usual heat transfer liquids and gases with a flowing solid. (B.O.G.)

16475

THE PROSPECT FOR A NUCLEAR POWERED DRY CARGO LINER WITH PARTICULAR REFERENCE TO THE ORGANIC MODERATED REACTOR. E. C. B. Corlett (Burness, Corlett and Partners Ltd., [Eng.]) and E. P. Hawthorne (Hawker Siddeley Nuclear Power Co., Ltd., [Manchester, Eng.]). J. Joint Panel Nuclear Marine Propulsion 4, 1-35(1960) Apr.

The features and problems governing the choice and installation of a marine reactor were studied. It was concluded that the organic moderated reactor appears to be suitable for application in dry cargo ships. A hypothetical comparison of the profit cargo on the assumed trade routes shows that nuclear ships are nearly as attractive commercially as conventional ships. (B.O.G.)

16476

SOME ASPECTS OF MARINE REACTOR SAFETY. K. Maddocks (Yarrow and Co., Ltd., [Glasgow]). J. Joint Panel Nuclear Marine Propulsion 4, 37-52(1960) Apr.

Engineering aspects of shielding, containment, and fuel element design are covered by analysis of the problems and suggestions for methods of calculation. Hazards peculiar to commercial marine installations are considered and safety recommendations made. A detailed survey is made of accidents to large ships over the last decade, from which are deduced guide lines on ship structure and equipment applicable to nuclear powered vessels. (auth)

16477

ATOMKRAFT. DER BAU ORTSFESTER UND BEWEGLICHER ATOMANTRIEBE UND SEINE TECHNISCHEN UND WIRTSCHAFTLICHEN PROBLEME. EINE KRITISCHE EINFÜHRUNG FÜR INGENIEURE, VOLKSWIRTE UND POLITIKER. (Atomic Power—The Stationary Structure and the Movable Atomic Drive and Their Technical and Industrial Problems—A Critical Introduction for Engineers, Political Economists, and Politicians). Friedrich Münzinger. Berlin, Springer-Verlag, 1960. 316p.

A survey of world-wide power reactor development for electric power and propulsion is presented in five parts. In a theoretical part, basic atomic physics is reviewed, and sections on reactor cooling systems and on structural and fuel materials are given. The technical part has an extensive section on reactor structure which discusses

fuel elements, the different reactor systems, thermal and biological shielding, control of reactors, accident hazards, removal of atomic waste, and heat exchangers and circulating pumps. Other technical sections are devoted to power-removal machinery for reactors, fuel material and structural material requirements of reactors, and the structure of the whole atomic power plant. The industrial part has sections on competitiveness of atomic power plants, German atomic power plant construction, and the atomic industry. The fourth part discusses atomic power and the second industrial revolution. Part five, Atomic Drives for Propulsion Installations, includes reactors for ships, airplanes, rockets, locomotives, and power trucks. (T.R.H.)

16478

NUCLEAR POWER PLANT SAFEGUARDS AND CONTAINMENT. Robert H. Shannon (United Engineers and Constructors Inc., Philadelphia). p.60-89 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

The discussion is limited to power reactors utilizing conventional heat-power cycles. The discussion includes such aspects as: reactivity control; safety and control systems; safety design philosophy; maximum credible accidents; design and construction codes; containment; containment vessels; site selection; radiation exposure, limits and units; waste disposal; fuel handling, transporting, and processing; and future considerations in design, construction, and operation. Current regulations and procedures covering permits and licenses for nuclear power plants are presented. (B.O.G.)

16479

LARGE ORGANIC COOLED POWER REACTORS. Ralph Balent (Atomics International, Canoga Park, Calif.). p.120-31 of "Proceedings of the American Power Conference, 21st Annual Meeting, Chicago, Illinois, March 31, April 1 and 2, 1959. Volume 21." Chicago, Illinois Institute of Technology, 1959. 807p. $8.00.

Eighteen months of operation of the Organic Moderated Reactor Experiment have confirmed the technical feasibility of the concept, and supplied the data necessary to establish the cost of organic make-up. The estimated total costs of the proposed larger plants are at 9 mills per kwhr. The physical properties—heat transfer, pyrolytic and radiolytic damage—are discussed for the organics proposed for reactor cooling. The design features of a 560 Mw, nominal thermal power reactor are tabulated. Possible coolant conditions for several lattice designs are listed. Uranium metal or uranium oxide elements can be used since no chemical reactions occur between the fuel and the coolant. (B.O.G.)

16480

NUCLEAR REACTOR OPTIMIZATION. P. H. Margen. Nuclear Engineering Monographs. New York, Simmons-Boardman Publishing Corporation, 1960. 88p. $2.75.

A nuclear reactor of any given type has several main design variables, which can be varied almost at will while still producing a reactor that will function safely and produce the desired electrical output. Only one combination of these independent variables will produce the lowest coat electrical output. The systematic methods are described which must be adopted to achieve this result. Their applications are illustrated in a completed example of the design and optimization of a nuclear power station. The discussion of optimization includes the physics, heat transfer properties, and thermodynamics of the system. (B.O.G.)

16481

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to General Electric Co.). British Patent 835,266. May 18, 1960.

A reactor and heat exchanger contained in one pressure vessel are described. Both a heterogeneous and a homogeneous system are described. (T.R.H.)

16482

CONVECTION REACTOR. R. P. Hammond and L. D. P. King (to U. S. Atomic Energy Commission). U. S. Patent 2,929,767. Mar. 22, 1960.

An homogeneous nuclear power reactor utilizing convection circulation of the liquid fuel is proposed. The reactor has an internal heat exchanger located in the same pressure vessel as the critical assembly, thereby eliminating necessity for handling the hot liquid fuel outside the reactor pressure vessel during normal operation. The liquid fuel used in this reactor eliminates the necessity for extensive radiolytic gas recombination apparatus, and the reactor is resiliently pressurized and, without any movable mechanical apparatus, automatically regulates itself to the condition of criticality during moderate variations in temperature and pressure and shuts itself down as the pressure exceeds a predetermined safe operating value.

Research Reactors

16483 IDO-16569

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THE MTR/ETR SAFEGUARD COMMITTEE. R. J. Nertney. Apr. 26, 1960. 10p. Contract AT(10-1)-205. OTS.

The working charter of the MTR/ETR Safeguard Committee is given. It describes the duties and functions of the MTR/ETR Safeguard Committee; documents certain existing procedures regarding reactor and experimental safety at the MTR and ETR; indicates those activities which require MTR/ETR Safeguard Committee approval; describes the procedures for obtaining such approval; and relates the activities of the MTR/ETR Safeguard Committee to the functions and responsibilities of Phillips Petroleum Company line supervision. (auth)

16484 IDO-16584

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

SPERT PROJECT. Quarterly Technical Report for April, May, June 1959. J. C. Haire, ed. Apr. 12, 1960. 43p. Contract AT(10-1)-205. OTS.

SPERT I: The characteristics of the boiling process and its relation to moderator expulsion in Spert I were investigated in a series of capsule type experiments. A fuel-bearing capsule, instrumented to provide pressure, volume, and temperature data during transient power excursions, was placed in a high flux region of the Spert I P core. Five step-induced transients initiated from boiling indicate that the kinetic behavior of the stainless steel clad P-18/19 core is dependent on initial temperature in a manner similar to that of previously tested aluminum clad Spert cores. Reactivity oscillator techniques were used in the P-18/19 core to determine the phase and magnitude of the reactivity-to-power transfer function from 0.01 to 18.4 cps at low power and at temperatures below boiling. Criticality data on relatively simple lattices, both rod-free and containing a single poison rod, were obtained

from a series of clean critical experiments performed on a number of light water-moderated and -reflected slab configurations of Spert III fuel elements. Changes in water height during the critical water height experiment were measured to ±0.0013 inches by means of a simple remote-indicating system designed and built for this purpose. SPERT III: The operational loading was determined to be 44 fuel assemblies and 8 control rods. Experiments revealed that this loading provides about $2.50 excess at 2500 psi and 650°C and a total rod worth above ambient critical of about $20.50. Measurements were made of the pressure and temperature coefficients of reactivity and the temperature defect. Apparatus for non-nuclear engineering tests was installed and the tests were initiated to obtain data on core hydraulics, system energy balance, and general plant equipment. A primary coolant sampling station has been added. Experimental apparatus for void experiments was designed and fabrication started. DATA REDUCTION AND INTERPRETATION: A review of previous investigations of boiling and its relation to shutdown effects was made in pursuance of a photographic investigation of shutdown mechanisms. A photographic technique was developed for conducting tests in a fuel-bearing, water-filled test cell in Spert I. A machine program using computed reactivity as input data was used to obtain power solutions to the kinetics equations. Comparison of the computed and experimental power burst shapes showed the reactivity data and power data to be consistent and in this way has essentially verified the independent program for reactivity calculations. ENGINEERING: Corrosion and galling tendencies were investigated in materials of construction for threaded components used in high temperature demineralized water service. The Spert II primary piping system was completed. Calibrations, check-out, and final tests are in preparation. Work continued on control system wiring, wiring schedules, and schematic drawings. The initial core was accepted. (For preceding period see IDO-16539.) (auth)

16485 LA-1172(Del.)
Los Alamos Scientific Lab., N. Mex.
A DESIGN FOR A ROTARY REACTIVITY CONTROL FOR A TEST REACTOR. V. Josephson. Sept. 18, 1950. Decl. May 13, 1960. 12p. OTS.

Tests made on a $U-U^{235}$ reacting assembly indicated that the lateral displacement of two halves of the active material within the assembly could be used as a control mechanism on this type of reacting assembly. A reacting assembly using a rotary control mechanism based on this principle is described, and the sensitivity of control possible with such a device is indicated. (auth)

16486 RISÖ-12
Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.
LEAK TESTS OF THE BUILDINGS FOR THE DR 2 AND THE DR 3 REACTORS. J. Schiellerup Petersen and F. Heikel Vinther. Mar. 1960. 13p.

The Danish reactors DR 2 and DR 3 are housed in gas tight steel buildings, the primary function of which is to prevent escape of radioactive effluents in case of an accident. This report deals with the tests carried out to assure the effectiveness of the buildings. From the final measurements the leakage rates are estimated to 0.2% per 24 hours at 1.5 meter water (2 psig) for the DR 2 building and to 0.02% per 24 hours at 4.6 meter water (6.5 psig) for the DR 3 building. (auth)

16487
DESIGN OF THE WWR-C RESEARCH REACTOR. V. F. Kozlov and M. G. Zemlyanskii. Atomnaya Energ. 8, 305-15(1960) Apr. (In Russian)

The technological design and construction of the WWR-C (water cooled and moderated) reactor with two experimental loops in the active zone are described. Six of these reactors have gone into operation between 1957 and 1959 and five are under construction and test (four are designed for increased power). (tr-auth)

WASTE DISPOSAL AND PROCESSING

16488 HW-30041
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
CORROSION EFFECTS OF LOWERING THE pH IN TBP WASTE STORAGE TANKS. Norman D. Groves. Apr. 6, 1954. Decl. Mar. 24, 1960. 5p. OTS.

The corrosion effects of lowering the pH in TBP waste storage tanks were studied. Synthetic waste solutions from both the ferrous ammonium sulfate and oxalate flowsheets were prepared, and portions of each solution were adjusted to pH 7, 8, and 9. Two sets of specimens of SAE 1020 carbon steel were exposed in both the vapor phase and the liquid phase of each of these solutions for periods of one month and three months, respectively. The general corrosion, the maximum pitting, and the average pitting rates determined for each specimen were approximately 2×10^{-5}, 1.5×10^{-4}, and 1×10^{-4} IPM, respectively. The corrosion rates of the specimens exposed in the vapor and those exposed in liquid were the same order of magnitude. From these data, it is concluded that there is no significant difference in the corrosive effect on SAE-1020 carbon steel exposed to TBP waste at either pH 7, 8, or 9. The data revealed no significant difference between the corrosivity of waste produced with the ferrous ammonium sulfate flowsheet and the waste resulting from the oxalate flowsheet. (auth)

16489 TID-3553
Technical Information Service Extension, AEC.
FIXATION OF FISSION PRODUCTS. A Literature Search. Theodore F. Davis, comp. May 1960. 13p. OTS.

This literature contains 94 references to report and published literature in the field of fission product fixation in ceramics, glasses, and various other solid media. (W.L.H.)

16490
METHOD FOR THE RECOVERY OF CESIUM VALUES. S. J. Rimshaw (to U. S. Atomic Energy Commission). U. S. Patent 2,925,323. Feb. 16, 1960.

A method is given for recovering Cs^{137} from radioactive waste solutions together with extraneous impurities. Ammonium alum is precipitated in the waste solution. The alum, which carries the cesium, is separated from the supernatant liquid and then dissolved in water. The resulting aqueous solution is then provided with a source of hydroxyl ions, which precipitates aluminum as the hydroxide, and the aluminum hydroxide is separated from the resulting liquid. This liquid, which contains anionic impurities together with ammonium and cesium, is passed through an anion exchange resin bed which removes the anionic impurities. The ammonium in the effluent is removed by destructive distillation, leaving a substantially pure cesium salt in the effluent.

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Vienna, International Atomic Energy Agency

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Munich, Technische Hochschule, Bibliothek

GHANA
Accra, University College of Ghana

GREECE
Athens, Greek Atomic Energy Commission

GUATEMALA
Guatemala, Comisión Nacional de Energía Nuclear

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Port au Prince, University of Haiti

HONDURAS
Tegucicalpa, Comisión Hondureña de Energía Atómica

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Bombay, Department of Atomic Energy

INTER-AMERICAN NUCLEAR ENERGY COMMISSION
Washington, D. C., Pan American Union

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Tel Aviv, Israel Atomic Energy Commission

ITALY
Milan, Centro di Studi Nucleari di Ispra del C.N.R.N.
Rome, Comitato Nazionale per le Ricerche Nucleari

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Tokyo, Science Section, Diet Library

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LEBANON
Beirut, American University

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NORTHERN IRELAND
Belfast, Department of Industrial and Forensic Science

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Lillestrom, Institutt för Atomenergi

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Lima, Biblioteca Nacional

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Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

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THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

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Ankara, Turkish Atomic Energy Commission, Atomic Energy Library

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Pretoria, Atomic Energy Board Library, Council for Scientific and Industrial Research

UNITED NATIONS
New York, N. Y., U.N. Headquarters

URUGUAY
Montevideo, Universidad de Montevideo

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Cientificas

VIET-NAM
Saigon, Office of Atomic Energy

YUGOSLAVIA
Belgrade, Federal Nuclear Energy Commission